OCTOBER, 1957

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Management's role in maintenance spells success or failure

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WORLD OIL

Established 1916 as The OIL WEEKLY

a quick look at WORLD OIL this month

BUSY OIL MEN: To help you put first things first, scan these time-saving digests on this and the following pages, checking ☑ those you want to read first.

CURRENT OUTLOOK

☐ **A budget is just as important** to a small or medium-sized operator as it is to a major oil company. This is especially true of the cash forecast and the estimate of taxable net income. The article beginning on Page 100 explains how this procedure can be applied and used as an important financial management tool. **Good Budgeting Essential to Independents**.....
Jarman Bass

☐ **Available capital is responsible** for some of the most important economic differences between small and large companies. The small company has limited capital. It must seek faster return of capital and quicker profit. The large company has large capital resources. It can move more slowly, act with more deliberation, and afford to wait longer for return of investment, ultimately showing more profit but over a longer period. The small company trades primarily in active areas, depending on its flexibility and speed in competing successfully with large companies for acreage. The small company has fewer labor problems and offers advantages that attract and hold employes. See **Page 103. How Small and Large Companies Differ**.....
Paul R. Schultz

☐ **Selecting the best man for promotion** is a tough job in any oil company. To make the job a little easier, an industry-wide survey was made to determine the most representative factors used in evalu-

Turn the Page ▸

This Month . . .

ating personnel. For the results—a composite list of 50 "plus" personality traits, read **Are You Ready for Promotion** ..... **Page 108**

☐ **Ability to write "saleable" articles for technical publications** and clear, concise reports has helped many an engineer up the management ladder. Others can do it, too, by adopting these four "rules of thumb" used by professional writers. You will also find a helpful checklist to guide you in writing technical reports. See **Page 115. Improve Your Writing Skill**..... **John L. Kent**

☐ **A sound business relationship** should be the aim of all dealings between drilling contractors and operators. Discussed on **Page 121** are some of the problems involved in achieving this goal. **What Makes Contract Drilling Successful**.....**Bart W. Gillespie**

EXPLORATION ARTICLES

☐ **An entire continent is being mapped as a unit.** The Inter-American Geodetic Survey has made considerable progress toward that objective. Many governmental and private firms are in on this program to provide topographic map coverage. Oil men stand to benefit greatly in the first effort of this type in history. Aerial photography, photogrammetry, and modern methods of compilation are being used. For the complete story, read . . . **Inter-American Geodetic Survey Will Greatly Aid Oil Development of Latin America** .....**Page 127**

☐ **Both independents and majors are being attracted** to the western flank of the Chautauqua Arch in eastern Kansas. What are the reasons? High discovery rates are stimulating both exploratory and development drilling. Turn to **Page 130,** for an outline of past and present activity in the area. **Activity Is Picking Up in Eastern Kansas**..... **F. W. Morgan and M. E. Torline**

☐ **You can determine** the magnitude of the component dip in a vertical plane, and in any direction with the nomogram shown on **Page 140. Component Dip Nomogram**.....**John Bemrose**

WORLD OIL, published every month except semi-monthly in February and August. Entered as THE OIL WEEKLY as second class mail matter December 23, 1916, at postoffice at Houston, Texas, under the act of March 3, 1879.

DRILLING ARTICLES

☐ **A serious slump in drilling activity** in the past year has forced contractors to avail themselves of every means at their disposal to stay in business. Some areas have been hit harder than others, with contractors stacking or selling their rigs. Just how hard have contractors been hit? What areas show the greatest decline in rig activity? Is this trend continuing, or are better days in sight? What factors have contributed to this economic depression? To get the answers to these and other questions, WORLD OIL went to the national and regional officers of the American Association of Oilwell Drilling Contractors. They have commented on the present status of the contractor in the various areas and what the future looks like to them. You will find these interesting and enlightening comments by the leaders of the drilling industry in **The Drilling Contractor: Present and Future**.....**Page 147**

☐ **Maintain or repair?** Does your Maintenance department establish ways and means of assuring that equipment is kept in a constant state of efficiency, or does it spend most of its time on repair and overhaul? Company management, through proper training of personnel, can establish proper attitudes and practices that will decrease downtime for repair of equipment. See **Page 156. How Management Fits Into Maintenance Program** .....**R. J. Bromell**

☐ **One method of controlling costs** for the drilling contractor has been devised whereby the 22 items of major expenses that lend themselves best to cost reduction are assigned an average standard value based on past experience. Actual cost figures are then compared to these figures to determine where cost savings can be effected. Turn to **Page 158** and find out how this method has worked. **Here's a Cost-Control Program That Works**.....**Dan Duncan**

☐ **A quick diagnosis of the causes** and application of proper cures for compressor unit ailments can save time and money. Here's an easy way to avoid the common breakdowns. See **Page 164. Diagnose Compressor Unit Ailments Quickly**.....**E. D. Couch**

☐ **Air systems are sometimes neglected.** Here are some instructions on how to install, maintain them, insuring fast, accurate and dependable response to the driller's touch. Turn to **Page 168. How to Maintain Rig Air Control Systems**.....**W. J. Taylor**

☐ **Detect engine trouble before it starts** with this set of periodic inspections. You can keep your engines on the line longer andcut down an maintee nance. See **Page176. Keep Your Engines Healthy**..... **Jesse W. Kehres**

This Month . . .

☐ **Slush pumps are built for rugged service,** but they are still subject to failure and short life if improperly assembled and operated. For a few words of caution and some easy-to-remember rules on slush pump maintenance, don't miss. . . . **How to Keep Slush Pumps in Top Operating Condition** . . . . . **Page 178**

☐ **Another installment** in a significant series. Continuing with the functions of the drilling fluid Authors Bobo and Hoch discuss the effect of the hydrostatic pressure on the fluid column and cleaning action beneath the bit. Turn to **Page 185,** for the second part of the fifth installment in this series on modern drilling technology. **Keys to Successful Competitive Drilling: Part 5B—Functions of the Drilling Fluid** . . . . . **Roy A. Bobo and Robert S. Hoch**

☐ **A drilling method of the future?** Drilling with casing and light-weight surface equipment by running the bit in and out on a wireline may be possible in the future. Recent laboratory and field tests with this new tool show that cost savings of around 25 percent can be realized on a 7500-foot hole. Details of both the three-and four-cone bits for this tool and test results can be found in the article starting on **Page 190. Development and Field Testing of Wireline Retractable Rock Bits** . . . **J. M. Camp, J. E. Ortloff** and **R. H. Blood**

☐ **Use of light-weight drilling strings** is expanding rapidly, as development of special tool joints leads to improved performance. Available data reveals 325,000 feet of drill pipe weighing under 14 pounds per foot soon will have been put into service since beginning of 1956. Reduced weight permits the use of smaller capacity rigs. Venezuela leads all areas with 15 strings totaling nearly 200,000 feet. Two strings have given excellent service in drilling almost 500,000 feet of hole in eastern Venezuela holes that have ranged down to 10,000 feet in depth. See **Page 195. Modern Light-Weight Drilling Strings Are Gaining in Popularity** . . . **Warren L. Baker**

PRODUCTION ARTICLES

☐ **More than 1000 wells have been stimulated** by fracturing in the San Juan Basin of New Mexico. The type fluid, size of treatment, sealing agents and injection rate are some of the chief factors that have led to recent fracturing techniques. Actual case histories of fracturing operations are presented on gas wells in this area producing from various depths. See **Page 205. Recent Developments in Hydraulic Fracturing** . . . . . **E. J. Coel, Jr.**

☐ **The segregation drive process** of oil recovery, when it can be used or induced, may prove to be the most efficient way of producing an oil field. The second part of a three-part series shows how segregation drive performance can be predicted. See **Page 209. A Universal Theory of Oil Reservoir Engineering (Part 2)** **Dr. S. J. Pirson**

☐ **Proper gas lift installation and design** is necessary for economical and satisfactory results under any given well condition. In the conclusion of a three-part series, the author explains the use of the subsurface plunger and its application to certain well conditions. Turn to **Page 216. "Graph System" Gives Gas Lift a Lift (Part 3)** . . . . . **E. D. McMurry**

☐ **Modern theoretical treatments of unsteady state-gas flow** based on Darcy's law do not fully explain gas well performance. These theories do offer explanations of the changes of well performance with time; however, further theoretical studies of gas flow are needed. See **Page 222. How Does Theoretical Gas Well Performance Compare With Field Data?** . . . . . **J. S. Miller**

☐ **The first dual well using concentric tubing strings for corrosion control** has been completed west of Lafayette, La., by Sunray Mid-Continent Oil Company. Inhibitor injected under pressure into the annulus between strings of 2⅞-inch O. D. and 1¼-inch nominal diameter tubing reaches the lower portion of the well. This unique installation offers several advantages over a conventional installation other than controlling corrosion. Turn to **Page 228. Dual Concentric Tubing Strings Designed for Corrosion Control** . . . . . **Perry R. Hillegeist**

INTERNATIONAL ARTICLES

☐ **The challenge of Papuan jungles** and rain forest haven't kept men and machines out. What may be the largest seismic field party in the world currently is operating there. Helicopters have increased the output and reduced the cost of operations significantly. See **Page 235 for 'Copters Triple Output of Exploration Party in Papau** . . . . . **A. B. Malone.**

☐ **Arabian American Oil Company** next year will celebrate its first quarter of a century in Saudi Arabia. And in those 25 years, one of the major oil centers of the world has emerged from the sandy fastness overlying the major underground oil reservoirs characteristic of many areas of the Middle East. Too, the community of Dhahran, company headquarters, has grown from a small village to a self-contained "oil city" for company employes. **Aramco Is Nearing Its 25th Year in Saudi Arabia** . . . . . **Page 242**

Turn the Page ▶

Next Month . . .

Geophysical Advancement Issue

FINDING PETROLEUM in the U. S. has become increasingly difficult and expensive in recent years. As more fields are discovered, those remaining to be found are not only fewer in number but also better hidden.

At the same time, additional fields are needed in greater numbers than ever before. Demand for petroleum continues to increase to ever greater proportions.

In these circumstances, petroleum exploration men are under tremendous pressure. It is demanded of them that they find more and more petroleum, although the undiscovered reserves are diminishing.

While their job is hard, the exploration men are not dismayed. On the contrary, they are confident that vast quantities of petroleum remain to be found over extensive areas favorable for petroleum accumulation. They are confident, furthermore, that the accumulations can be found, though conceding that success won't come easy.

To find the vast amounts of reserves needed will require much hard work, increased knowledge, ingenuity, better methods, and better tools.

A key figure in the exploration job is the geophysicist. He has taken a prominent role in finding oil and gas for more than 30 years. He will continue to take a vital part in the increasingly urgent search for new fields.

To fulfill their responsibilities, the geophysicists are constantly perfecting and improving their methods and their interpretations of the data they work with. The equipment employed in seismic, gravity, magnetic, and other geophysical work likewise is being constantly improved.

The Geophysical Advancement Issue of WORLD OIL, scheduled for November, 1957, will contain a variety of articles revealing current progress in geophysical methods and equipment. Officials of several geophysical service companies will be among the authors. The articles will deal with such subjects as recent developments in seismic data processing, the use of continuous velocity logging, and a new plotting machine developed by a major oil company to facilitate handling of seismic exploration data.

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Indexed by Industrial Arts Index and Engineering Index

WHO'S MEETING WHERE

OCT.	
1– 2	Texas Mid-Continent Oil & Gas Association, 38th Annual Meeting, Texas Hotel, Fort Worth.
1– 4	National Association of Corrosion Engineers, South Central Region, Municipal Auditorium, Oklahoma City.
5– 8	National Association of Corrosion Engineers, Northeast Region, Hotel Somerset, Boston.
6– 9	AIME, Petroleum Branch, 32nd Annual Fall Meeting, Adoo, Adolphus, Baker & Statler-Hilton Hotels, Dallas.
7– Nov. 15	School of Production Technology, Fall Term, Kilgore College, Kilgore, Texas.
7– 9	American Gas Association, Annual Convention, Kiel Auditorium, St. Louis.
10–13	Louisiana Gulf Coast Oil Exposition, Lafayette, La.
13–15	American Association of Oil Well Drilling Contractors, 17th Annual Meeting, Mayo Hotel, Tulsa.
13–18	Oil Progress Week.
15–16	Fifth Annual Gas Measurement Institute, American Legion Hall, Liberal, Kansas, sponsored by University of Kansas and Southwest Kansas Petroleum Industry.
15–18	Society of Mining Engineers, AIME, Annual Meeting and Southeastern States Mining Conference, Hillsboro and Tampa Terrace Hotels, Tampa, Fla.
17–18	Society of Petrolem Engineers of AIME, So. California Petroleum Section Fall meeting, Biltmore Hotel, Los Angeles.
17–19	Panhandle Geological Society Field Trip of Southwestern Oklahoma, Panhandle Geological Society of Amarillo, Texas, and School of Geology, University of Oklahoma.
18–19	Symposium, "Legal Problems in the Tidelands," Dixon Hall Auditorium, Tulane Campus, Tulane University, New Orleans.
21–25	National Safety Congress and Exposition, 45th Annual, Chicago.
23–24	Science Symposium, Centennial Year, St. Bonaventure University, Saint Bonaventure, N. Y.
23–25	National Association of Corrosion Engineers, Seventh Biennial Permian Basin Corrosion Tour, Odessa-Midland Area.
24–25	Rocky Mountain Oil and Gas Association, Mid-Year Meeting, Northern Hotel, Billings, Mont.
25–26	Field Trip in San Saba County, Texas, Abilene Geological Society and Fort Worth Geological Society.
27–29	Independent Petroleum Association of America, Annual Membership Meeting, Statler-Hilton Hotel, Dallas.
30– Nov. 1	AIME, Rocky Mountain Mineral Conference, Denver.
31– Nov. 1	AAPG Mid-Continent Regional Meeting, Cimarron Ballroom, Tulsa.
NOV.	
6– 8	Gulf Coast Association of Geological Societies, 7th Annual Convention, Roosevelt Hotel, New Orleans.
6– 8	Tracerlab Inc. Oil Symposium, Houston.
10–14	SEG National Convention, Statler-Hilton, Dallas.
11–14	API 37th Annual Meeting, Conrad Hilton Hotel & Palmer House, Chicago.
13–16	National Association of NACE, Miami Section, Key Biscayne Hotel, Key Biscayne, Fla.
DEC.	
5– 6	API Oil Information Committee Meeting, Biltmore Hotel, New York City.

Nomads' Chapter monthly meeting: Los Angeles, second Wednesday, Jonathan Club, Wallace A. Sawdon, Secretary. Houston, second Monday, Ye Old College Inn, Harry E. Estes, Secretary. Dallas-Fort Worth, first Monday, Greater Dallas Club, Hank Davis, Secretary. Tulsa, Hotel Tulsa, Gilbert Swift, Secretary. New York, first Monday, Hotel Biltmore, Jesse E. Hickman, Secretary.

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86 YEARS OF PROGRESS WITH THE OIL INDUSTRY

Looking Ahead . . .

Crude Output to Drop Further in October . . . U. S. Crude oil production will be further drastically curtailed in October. The Texas Railroad Commission cut the Texas allowable by 228,075 barrels daily for October. It ordered only 12 days of production during the 31-day month. That meant a calendar daily allowable of 2,964,062 barrels, the lowest for about two years. The 12 producing days for October compared with 13 each in July, August, and September and a minimum of 15 in prior months.

After shooting up last February and March to a record high, Texas crude production allowables were cut lower each month in April, May, June, and July; were kept about unchanged on 13 producing day schedules in August and September; and will be further cut in October.

U. S. crude production jumped to 7.8 million barrels daily last March. It was down 1 million barrels to 6.8 million daily in August, rose slightly in September, and apparently will drop to only about 6.6 million barrels per day in October.

Petroleum Demand Not As Good As Expected . . . Demand for petroleum has continued sluggish and below earlier estimates. Total domestic and export demand has been estimated by Independent Petroleum Association of America at 10 million barrels daily for the fourth quarter of this year. That would be an increase of 261,000 barrels daily or 2.7 percent over the fourth quarter of 1956.

Domestic consumption is estimated at 9,670,000 barrels daily. That would be an increase of 7.1 percent over the same quarter of 1956, when fuel oil demand was depressed, due to warmer than normal weather. But export demand is expected to average only 330,000 barrels daily, down more than 50 percent from the same period last year, when shipments to Western Europe were abnormally high because of the Suez crisis. IPAA stated that during the recent three months, June, July, and August, total domestic and export demand averaged 8,625,000 barrels daily. That was an increase of only 73,000 barrels daily, or less than 1 percent, over the same period last year.

Active Drilling in Panhandle Indicated . . . The Texas Panhandle area gives the greatest promise for a high, sustained rate of exploration for the balance of 1957 and early 1958. However, lack of market, coupled with large lease blocks will keep drilling orderly. In other words, do not look for an old fashioned "boom." In Western Oklahoma look for an increase in medium to deep drilling, where 640-acre spacing prevails. An estimated one half of present operations are contracted for 5000 feet or deeper.

Damage to Land Prevented . . . In moving seismograph equipment across the range in the Rockies, oil companies have generally agreed to just skim the surface of the ground and remove the brush, thereby leaving the grass to grow up on these cleared areas. This prevention of erosion is in the public interest and deserves to promote industry public relations.

Florida's Offshore Has Seismic Work . . . Interest continues in the offshore possibilities off Florida in the Gulf of Mexico. Humble Oil & Refining Company was active during late summer 1957 with seismic operations there. Magnolia Petroleum Company also was reported moving in an offshore seismic party.

West Coast Oil and Gas Imports to Rise . . . Fifty-five percent of West Coast overall energy requirements must be supplied from outside the area's states of California, Nevada, Arizona, Washington and Oregon by 1966, as compared with 28

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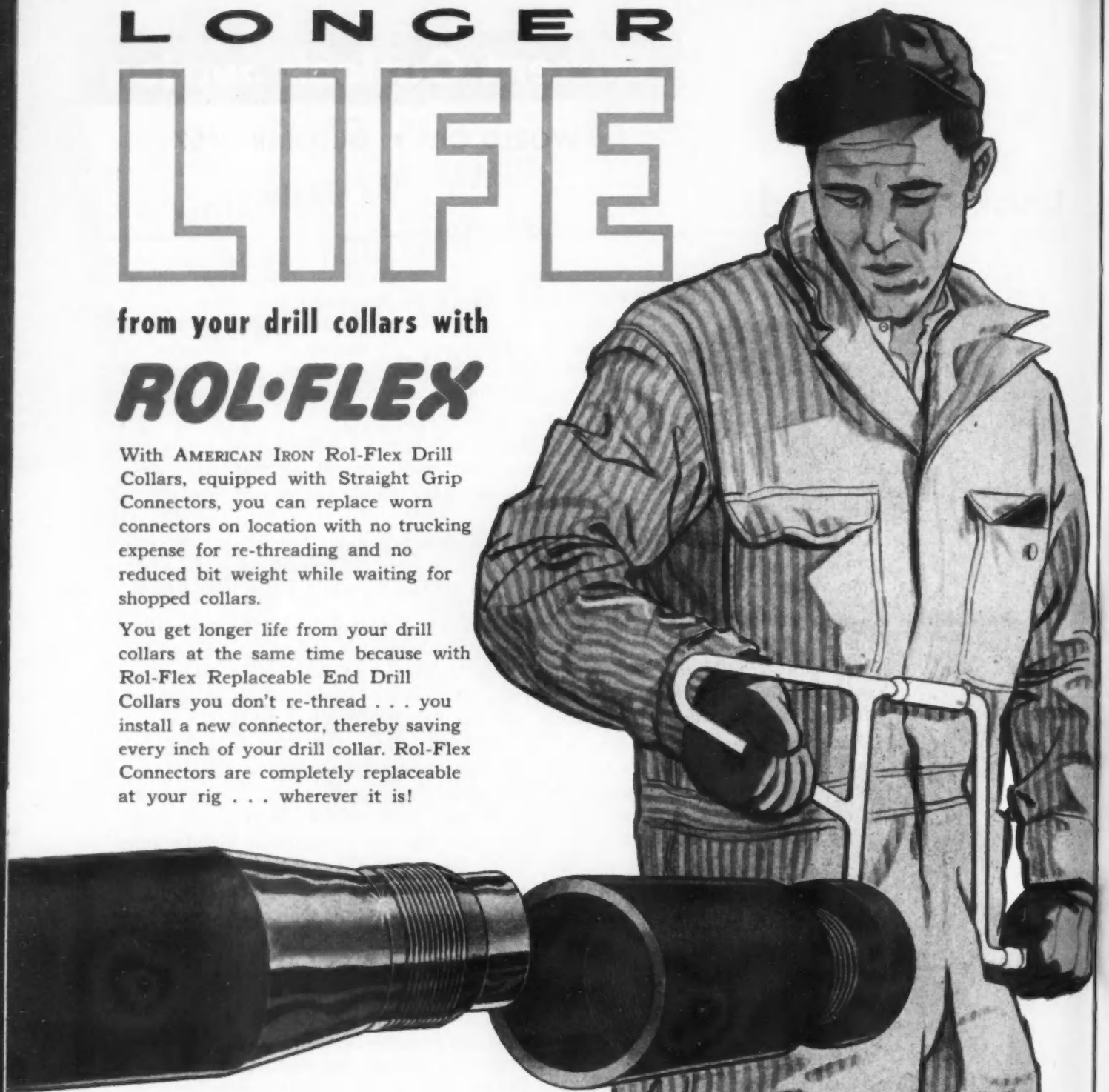

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percent in 1956, according to the report "Future Growth of the West Coast Petroleum Industry," recently released by Chase Manhattan Bank.

Oil production on the West Coast is estimated to decline slightly from 1,044,000 barrels daily in 1956 to 1,040,000 per day in 1966, assuming that offshore oil production will increase from 3000 barrels per day in 1956 to 100,000 barrels daily in 1966.

Total consumption of natural gas during the coming decade is estimated to see an increase of 86.1 percent, with gas from outside sources increasing by 161 percent from 1956 to 1966, and indigenous production decreasing by 13.3 percent.

The share of the West Coast's energy market fulfilled by petroleum and natural gas is expected to increase from 90 to 94 percent during the same period. Future growth rate of petroleum demand will depend importantly on the degree of competition from natural gas.

British Atomic Supertanker Planned . . . Two private British companies are reported to have agreed upon a plan to build an atomic supertanker, and were awaiting the reaction of the British Admiralty to the proposal. Chances were considered good that the ship would be built if the Admiralty would assist in financing, poor if no such help is approved.

Government Appeals in Mid-East Case . . . The Department of Justice filed an appeal on September 13 in the case of U. S. vs. Standard Oil Company of California, The Texas Company, Bahrein Petroleum Company Ltd., California-Texas Oil Company Ltd., Caltex Oceanic Ltd., and Mid-East Crude Sales Company, alleging overcharge for sales of crude oil to the Economic Cooperation Administration and its successor, the Mutual Security Agency, pursuant to financing of European purchases of Saudi Arabian crude from September 1, 1950, to August 31, 1952.

The government had taken a beating when the case was thrown out of court on July 17, 1957, in a 79-page, point-by-point refutation of the charges, by Judge Thomas F. Murphy, of the U. S. District Court, Southern District of New York.

EVERY YEAR about this time we like to remind our readers that WORLD OIL is one of 11 oil industry publications (there are about 30 in all) which are allowed to carry the symbol of the Audit Bureau of Circulations.

"What's so important about belonging to ABC?", you

AUDITED PAID CIRCULATION ABC **a matter of pride**

may ask. The answer lies in the a-b-c's of business publication philosophy:

A. To keep from charging you about $20 a year for one WORLD OIL subscription (compared with our present rate of $2 per year), we must have advertisers.

B. To have advertisers, we must attract enough of the right type of subscribers. The right type are those high enough in their company to influence the purchase of equipment and supplies.

C. And, to attract enough of the right type of subscribers, we must provide a high quality editorial service to our readers.

This is where the Audit Bureau of Circulations comes in. The Bureau sets standards for the definition and measurement of paid circulation, verifies adherence to those standards by its publisher members and disseminates circulation reports.

These up-to-date, audited reports help advertisers to exercise correct judgment in deciding which publications will give them the most for their advertising dollar.

When you see the ABC symbol in a publication (on Page 6 of this issue) it means that you, the reader, are the boss. And the editors know it. When we study our ABC audit report we find out in a hurry if we are earning our keep, i.e., maintaining a growing list of satisfied subscribers. This, plus increased advertising sales, is the ultimate reward for editorial initiative and leadership.

In turn, ABC circulation reports tell our advertisers what types of men in the industry, and how many, have selected WORLD OIL to keep them abreast of the economic and technical developments in the oil industry. To justify this selection, we must demonstrate responsiveness and a responsibility to our readers. Otherwise, we would be on the outside of ABC—and your paid subscription—wishing we could get in.

The latest ABC report shows WORLD OIL among the leaders in attracting enough of the right type of subscribers for our advertisers.

These are the reasons why we are proud of our ABC membership and want you to know about it.

Good Wells Make Good News

October, 1957

DOWELL FRACTURING SERVICES are designed to give you good results and quick return on investment. They are offered in all volumes and injection rates, with a wide variety of fracturing fluids and addition agents. Here are some recent outstanding examples of the results obtained from Dowell fracturing services.

- **Ward County, West Texas** (Old Well): Gyp deposits had reduced production from well in waterflood project (Yates formation) to 20 bopd. Monthly workovers in this field, to remove gyp from pumps, were not uncommon. This was increasing production costs. Dowell recommended Sandfrac®, using 5000 gallons lease crude with 10,000 pounds sand and 600 pounds Gypban* to prevent the formation of gyp deposits. Injection down casing averaged 32.8 bpm. *Four months after treatment, production had stabilized at 115 bopd—without requiring a single workover. Treatment cost of $2,717 was recovered during first two weeks after treatment.*

- **Crawford County, Illinois** (New Well): Completion was made by perforating between 1450 and 1518 feet in two zones of the Benoist and one zone of the Aux Vases. Dowell recommended Petrojel* using 9000 gallons thickened crude and 13,500 pounds sand. Treatment was in three, 3000 gallon stages. 52 Buna-N—covered nylon balls were injected during stages to plug, temporarily, zones already fractured. From a show of oil before treatment, well swabbed 10 boph following Petrojel service and was put on pump at 140 bopd. *Treatment costs of $1,343.45 paid out in less than 14 days.*

- **McPherson County, Kansas** (Old Well): Production from perforations in Maquoketa dolomite (3326 to 3356 feet) had declined to 10 bopd. Dowell fractured with Stratafrac®, using 3000 gallons acid-kerosene emulsion and 3250 pounds sand. Injection was down tubing. *Immediately following treatment, the well tested 60 bopd. 330 days after treatment, well was still producing 35 bopd. Total cost of Stratafrac service paid out in less than 60 days.*

- **Major County, Oklahoma** (Old Well): Production from Manning formation through perforations, 6745 to 6835 feet, had decreased to 5 bopd. Operator ordered Riverfrac*, using 150,000 gallons fresh water with 12,000 gallons Dowell "X" Acid and 100,000 pounds sand. Treatment was down 5½-inch casing at 45 bpm average. *After 60 days, well had stabilized at 38 bopd.*

For quick payout and good ultimate recovery, start with the right treatment. Let your Dowell engineer tailor your fracturing treatments to the requirements of your wells. For service call any of the 165 Dowell offices in the United States and Canada; in Venezuela, contact United Oilwell Service. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry DOWELL

A Service Subsidiary of The Dow Chemical Company

*Trademark of Dowell Incorporated

Imports Jeopardize U. S. Oil

Immediate curtailment of U. S. crude oil imports is necessary. This becomes increasingly clear each week. To combat excessive supply, U. S. crude production has been cut so drastically in recent months it cannot be curtailed any further. Therefore, reduced imports are the only remaining means of relieving the severe oversupply confronting U. S. producers.

The situation is serious and becoming more serious each week. Consequently, the need for quick action.

The toughest kind of economic squeeze has hit U. S. oil producers. Labor and equipment costs have risen sharply at a time when drastic reductions in producing allowable have curtailed producer income.

Hardest hit are the numerous independent producers. Because they have less operating capital, they must have faster payouts than the larger better-financed companies. Unless there is immediate improvement in the economic position of the industry, many small independents and small venture capital investors are in serious jeopardy of being driven from the oil business. This would be most unfortunate. It would be a severe blow to the industry and to the national economy and security.

The vigor of thousands of independents in searching for new fields has contributed much to the dynamic character of the U. S. oil business. They are responsible for much of the industry's exploratory activity, which has led to the discovery of large quantities of oil. Without the contribution of independents, the U. S. supply of oil would now be far below its present magnitude. This country would not have had an adequate supply to fulfill emergency needs during World War II or the more recent Suez Canal crisis.

It is important, in fact vital, that the independent producing segment of the industry be preserved. They must have sufficiently attractive financial conditions to be willing to continue taking long-shot risks. Present conditions do not provide adequate financial reward possibilities to encourage such risk-taking ventures.

Other branches of the industry also are affected by present conditions. As long as U. S. crude production is curtailed so drastically there is also a sharp reduction in income of pipe line companies. There is no incentive or need for construction of additional pipe line capacity.

The recent Suez Canal crisis proved the need for enlarged pipe line capacity. Oil is of no value unless pipe lines are available to move it to refining centers.

A solution which will provide some relief for U. S. producers must be found. Otherwise, the U. S. supply of oil may experience such extensive damage as to become a national catastrophe when the next national emergency strikes. Since U. S. crude production already has been cut beyond reasonable volumes, the only remaining possibility is to curtail imports.

Time is essential. The import problem will become increasingly serious. A growing number of U. S. companies are starting operations outside this country. Many of these are independents who have no market connections abroad, hence can hope to sell their oil only in the U. S.

If the present government request for voluntary reductions by importing companies does not succeed in bringing reasonable imports, some other method must be adopted without delay.

Warren L. Baker

Good Budgeting Essential to Independents

Small and medium sized operators, as well as major companies, must make forecasts in planning ahead.

In his budgeting the independent needs to apply especially the cash forecast and the estimate of taxable net income.

Forecasts help assure adequate cash for operations and best use of cash.

Tax estimates help the operator to take maximum advantage of tax benefits and savings that are available.

By Jarman Bass
Arthur Andersen & Co.
Dallas

IT IS AS IMPORTANT to small and medium sized oil operators as to major companies to follow proper budgeting procedures as they apply to the cash forecast and the estimate of taxable net income. Such forecasts and estimates represent valuable financial management tools. They should not be neglected by any individual or company engaged in oil operations, which at best are hazardous and complex.

A cash forecast is nothing more than a projection of the source and use of money for a given future period. As such, it represents the expected cash flow under a given set of circumstances. A tax estimate simply restates the cash forecast in terms of tax effect, and takes into consideration depreciation, depletion, abandonments and operating loss carryovers which have not previously been shown.

Like any other gage or measuring instrument, forecasts must be fairly accurate if they are to be useful. Furthermore, a sound forecast can only be built on a sound knowledge of operations. There are four basic elements which may be applied to any phase of forecasting.

1. Study of past experiences.
2. Review of future requirements.
3. Subsequent comparison of actual results with original forecasts.
4. Improvements in future forecasts.

Purpose of Forecasts. The principal use of cash forecasts is to indicate the probable effect of a contemplated course of action on the cash position of the enterprise. The ultimate goal of such planning is, first, to provide an adequate supply of cash and, second, to obtain the most effective use of that cash. The forecast then should be used to determine, first, that adequate cash will be available to finance the management's proposed plan of operation and, second, that management's proposed plan of operation will make the best use of the cash available.

Small Firms Have Special Needs. The nature of the small and medium-sized oil operators' business is such as to make it particularly well suited for the cash forecast-tax estimate type of budgeting because:

1. Increasingly larger sums of money must be made available and spent to find reserves to replace the minerals currently being produced and sold.
2. Advance planning is frequently necessary in order to take maximum advantage of the tax benefits available to the oil industry.

Conventional Budgets Not Suitable. The more complete, conventional forms of budgets common to other industries are difficult to apply to a small oil operation because:

1. Income, to a large extent, cannot be estimated as accurately, since it is affected by new drilling activity, state conservation regulations or pipe line proration.
2. Balance sheets and income statements cannot be projected as realistically because of the inability to accurately forecast the results of drilling activity.

How Far Ahead? Various periods have been recommended for coverage in budgets and forecasts. Some companies like to prepare short range forecasts in considerable detail, while at the same time making more general, long range plans. Others try to budget by months and quarters, while some forecast on an annual basis only. Most independent operators can do their forecasting effectively on an annual basis, since their operations are so closely tied to tax results.

In most cases, forecasts by independent operators need to be revised frequently as new factors develop dur-

ing the year. As a very minimum:

1. The best possible forecast of the coming year's operations should be prepared as close to the beginning of the year as possible. This forecast should indicate to what extent additional cash will be needed or to what extent exploration can be stepped up. It should also allow the maximum available time to act on such information.
2. A more careful forecast should be made shortly after mid-year. After six months or more, this forecast should indicate to what extent the original plan has been followed to date and to what extent revisions may be required before year end.
3. A last look should be taken at the beginning of the last month of the year to determine what final steps, if any, can be applied to develop the desired tax result.

Cash forecasts may be in varying detail, depending on the company, and may be prepared either on an overall basis or by lease, by district or by area. Expense budgeting, however, should be by organizational responsibilities, and should involve responsibility accounting to establish control in an animate way. Since effective control over people must follow their actual responsibilities, accounting and forecasting must not only be parallel to each other but they also must be parallel to the organization chart.

The estimate of oil and gas sales and lifting expenses should be prepared by, or certainly with the active cooperation of, the people in the production department, under the guidance of the production superintendent. To the extent that their on-the-job familiarity is required, field personnel should be asked to assist. Estimates should be prepared on the basis of anticipated production from old leases, allowing for normal production declines and the effect of regulatory or pipe line proration. New production from development wells, and also increased extraction due to planned work-overs, should be included on a conservative basis. The estimate for lifting expenses, including district office and other indirect operating expenses, should show the effect of recent or anticipated salary and personnel changes, along with other known changes in taxes and maintenance.

Production personnel should also prepare the estimate of the cost of known, required capital additions to producing leases as well as the cost of development drilling.

General Expenses. General and administrative expenses and debt service usually can be worked out by the controller, after discussing the broad objective with top management. This estimate should, of course, include all the current estimates of personnel cost, office expense, outside fees and other such items.

Nonproducing lease rentals should be estimated by the land department on the basis of the properties held at the beginning of the year, giving effect to anticipated farmouts and trades. At the same time, an estimate should be made of nonproducing lease abandonments, which will be used later in the tax estimate.

Available at this point should be estimated cash income, lifting expenses, G and A, lease rentals, debt service, etc., or in other words, an indication of the cash throw-off from operations.

Lease acquisitions in attractive or promising areas, seismic exploratory work and wildcat drilling must be projected by the land or exploration managers, probably by both working together. Management must determine to what extent dividends or other distributions are desired. With this information, the cash requirements under a stated plan of operations are known.

Now Comes the Acid Test. Which is the greater of the two estimates? Does cash throw-off exceed requirements? If so, fine! If not, how can the two be brought together?

The most realistic approach is, first, to restudy carefully the individual items which went into the cash throw-off determination. Make sure that no item of income or expenditure has been overlooked or improperly determined. Second, be sure that there are no available alternatives among the exploratory and distribution requirements that would yield the same, or comparable, result. Once having made this recheck, there are two courses to take.

1. Raise the necessary cash, or
2. Change the desired requirement plan.

Generally, at this point, top management decisions are required. Cash can be obtained either from sources within the business in the form of reduction of investments, receivables and inventory, or sales of property, or from outside sources in the form of short or long-term borrowing or equity financing. Ordinarily, temporary shortages of capital can be replaced advantageously by short-term borrowing. However, the replacement of permanent shortages of capital requires much more careful consideration.

On the assumption that the problem of bringing cash throw-off and cash requirements together was either nonexistent or has been solved, attention can now be directed toward the preparation of the tax estimate.

The tax estimate may be considered the end result, or a by-product, of the cash forecast, depending on which is more important—cash or tax control. Once having determined what the plan for the year is to be in terms of cash result, the tax estimate can then be prepared by taking into consideration the effect of the noncash items of depreciation, depletion, abandonments and operating loss carry-overs.

With the exception of abandonments, which should be determined by, or with the help of, the land department, these factors can be developed by the controller on the basis of information already at hand. Depreciation will be based upon previously established basis, investment and

About the Author

JARMAN BASS graduated from Baylor University, Texas, with a BBA degree. After three years of military service, he joined Arthur Andersen & Company in Houston, Texas, in 1946. He was promoted to Audit Manager and transferred to Dallas upon opening of that office in July, 1951. He was admitted to partnership in July, 1956. Mr. Bass is a C.P.A. and a member of the American Institute of Accountants, the Texas Society of C.P.A.'s and the Dallas Petroleum Accountants Society.

reserve balances, plus the effect of currently estimated additions. Allowable depletion often can be estimated on the basis of prior years' experience. However, in most instances it is preferable to make a detailed, lease-by-lease computation in order to point up in advance the properties on which full statutory allowances may be limited or otherwise in jeopardy because of too much drilling, etc. These situations, if they are known in time, often can be improved by a change in the plan for development drilling, coupled with the timely sale of production payments to accelerate income.

After abandonments and appropriate operating loss carry-over adjustments are shown, the net taxable result is determined. Obviously this result may have an effect on all of the previously estimated plans. For it may show that additional cash for taxes will be required, or perhaps that tax refunds may be available. In other cases, the tax result may necessitate an acceleration or slow-down in exploratory plans. For it is sometimes more desirable, from a cash standpoint, to pay a little tax than to attempt to drill up all the profit. Most successful oil men, particularly those who operate to a large extent on borrowed money, have had to find that happy medium which will permit them to drill or pay taxes and still have the required money left over to service their debt. Intelligent cash and tax forecasting are of considerable benefit in determining this optimum operating point.

Forecasting Is Planning Ahead. In summary, it should be remembered that budgeting must have the active support of the top man in the organization if the program is to be accepted by the other operating people. The heads of the operating departments must be convinced that the forecast will help them control their own operations and that the forecast is a valuable tool. Organizational structure must be well defined, and all areas of responsibility must be fully understood. Each supervisor should make his own forecast, based on what he knows to be his operating assignment. The most important thing is to plan ahead. The forecast is merely an aid in carrying out the plan.

ACKNOWLEDGMENT

This article is based on a paper presented at the 1956 Petroleum Accounting Conference, Wichita, Kansas.

If Oil Could Speak

If oil could speak it would have many fascinating truths to tell the non-oil public—truths that would win thousands of new friends for the oil industry.

But, oil can't speak—you can. You, as an individual, can win many new friends for the oil industry if you will pass the true facts on to your non-oil industry friends.

Here are some of those true facts. They are being presented for one purpose: To keep you posted on your industry, so you can tell the story oil is unable to relate.

Read these facts. You will find them informative—and interesting.

"If Oil Could Speak" it would tell the American public:

Is Oil Research Comparable with Other Industries?

Expenditures on research for a new manufactured product seldom exceed five percent of gross income, whereas expenditures for petroleum exploration and dry holes require about 30 percent of the gross income of the industry, exclusive of development expenditures which represent an additional 35 percent of oil's gross income. This also is research. Furthermore, much research leads to improvements in existing processes and equipment which will pay for the cost of the work, whereas the search for oil must discover new deposits comparable with new inventions in order to result in any source of income.

Is Oil a Good Investment?

Out of the 27 industries that have stock listed on the New York Stock Exchange, petroleum ranks second in the line-up of securities which pay the highest dividends to investors.

Has Gasoline Efficiency Increased?

Gasoline efficiency has increased 77 percent since 1926, yet today's gasoline costs only about a penny more per gallon than it did 30 years ago (sans taxes).

Have Oil Prices Kept Pace With Cost?

No. While crude oil prices have increased only nominally in the past decade, exploration, development and production costs have more than doubled.

What Lies Ahead in Petroleum Demand?

Since 1946, the combined use of oil and gas in the U. S. has approximately doubled. Since population has increased less than 20 percent, this means a rise in per capita consumption of oil by more than 60 percent within 10 years. The use of oil will continue to increase rapidly and is expected to double within 15 to 20 years.

How Many Miles of Pipe Line are in the U. S.?

Today, networks of 190,000 miles of pipe lines for crude oil and oil products crisscross the nation. They move oil steadily from wells to refineries to consumers. They are one of the big reasons why the oil industry has been able to serve the American people economically and efficiently.

How Small and Large Companies Differ

They have one common goal: profit. But the way they go about it differs greatly.

By Paul R. Schultz, President
Blackwell Oil and Gas Company, Tulsa

How do operations of small and large companies differ as to economic factors involved? There is little difference in economic factors as such as each type of firm has a basic objective: To make a profit. This common denominator effectively prevents the wide gulf that many assume must exist in the individual economic concepts of large and small company operations.

The profit motive is fundamental to all companies. It follows naturally that similar yardsticks are used to determine the possibility of profit in a particular venture.

Common to all operating firms, of whatever magnitude they may be, are payout periods, profit ratios and tax considerations. However, the scale of operations does affect the emphasis that the various economic factors receive. There are major differences in methods and procedures between the large and the small company. Each must give proper value to every economic factor in light of its own financial reserve limitations.

Identification. To relate the economic factors involved in large and small scale operations properly, only firms having 50,000 or more barrels per day, or those having less than 3000 barrels daily of production will be considered. The medium-sized firms lying between these limits combine operating procedures of both the large and the small company, as might be dictated by the requirements of any particular venture. They are not truly reflective of the economic policies of either group.

The major difference, and the only true economic difference, between the large and small company is availability of capital. The large company has capital available to it in large amounts and from varied sources. Any program its organization might develop is feasible. Whether the investment required for a given venture that management thinks would be profitable is a few thousand or many millions, the money is available.

The small company must often reject desirable projects developed by its personnel or presented for its consideration by others, simply because of the magnitude or duration of the necessary expenditures.

The major company can devote several years to the geological and geophysical investigation of a given area, take whatever additional months or years are needed to acquire a lease block, spend additional time intensely reviewing the leases, and finally drill a deep wildcat. It can afford to invest more time and money in preliminary investigation and take greater risk on the outcome.

Small Company Capital. The small operator cannot afford to tie up significant amounts of capital on ven-

SOME IMPORTANT WAYS IN WHICH A SMALL COMPANY OPERATES DIFFERENTLY FROM A LARGE COMPANY

Seeks faster pay-outs

More limited capital of small company is a major factor causing it to operate differently. Small concern cannot afford to tie up significant amounts of capital over long periods. It must seek faster recovery of investment and quicker profit.

Specializes; foregoes diversification

The small company does not have sufficient funds to diversify operations, as the large company can do. Ventures offering low return are undesirable for small operator, though perhaps satisfactory for major concern.

Buys leases in active areas

Small company must confine lease holdings to active areas and trade fast. Large company can hold big acreage blocks in widely scattered areas for longer periods.

Decides and acts fast

Ability to make decisions and act promptly enables small company to compete with major company.

Has no labor problem

Labor problems common to the large company are nearly non-existent in the small company. By virtue of its size, the small concern is ignored by unions and it is closer to its employes.

Offers advantages to employe

Small company offers employe variety of duties and freedom of action. Greatest selling point of larger firm is the security it offers. Both small and large companies have their own attractive characteristics. Each is essential to the industry as a whole.

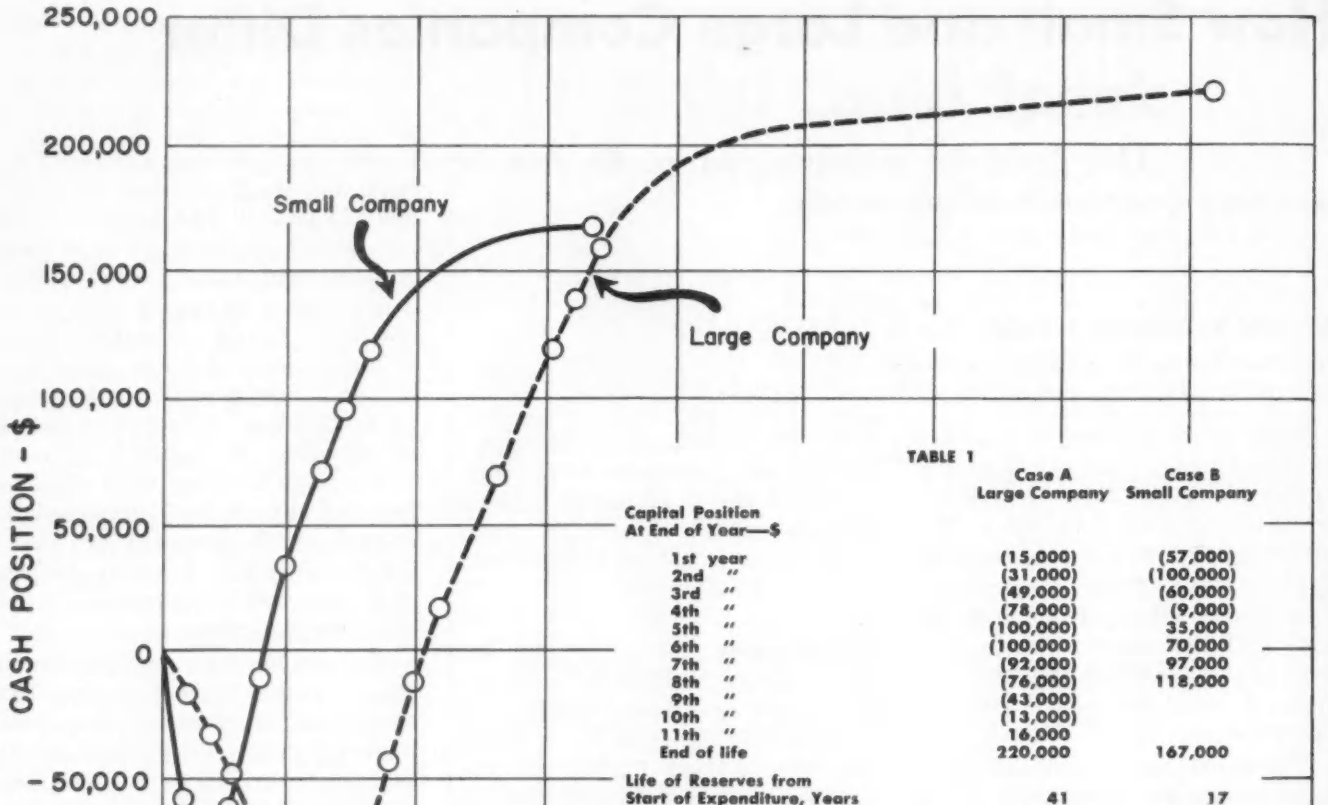

TABLE 1

Capital Position At End of Year—$	Case A Large Company	Case B Small Company
1st year	(15,000)	(57,000)
2nd "	(31,000)	(100,000)
3rd "	(49,000)	(60,000)
4th "	(78,000)	(9,000)
5th "	(100,000)	35,000
6th "	(100,000)	70,000
7th "	(92,000)	97,000
8th "	(76,000)	118,000
9th "	(43,000)	
10th "	(13,000)	
11th "	16,000	
End of life	220,000	167,000
Life of Reserves from Start of Expenditure, Years	41	17
Reserves Found and Produced, Barrels	230,000	126,000

SMALL COMPANY MUST RECOVER CAPITAL AND MAKE PROFIT QUICKER THAN LARGE COMPANY. Shown here by figures and graph are the results expected by a small company and a large company from contemplated investments of $100,000 each. Having limited capital, the small company sought a fast pay-out. Holding ample capital, the large company was willing to be in substantial out-of-pocket position for a long time. It expected much greater ultimate return, although over a longer period. Considering the discounted value of future income, the ultimate return expected in these two cases is quite similar.

tures involving expenditure of large sums over a long period with no certainty of the return of capital, much less of realizing a profit. It must look at plays which do not involve so much preliminary cost and where probability of return of profit is greater. Normally, the small producing company will do better to devote its attention to proven and semi-proven areas, leaving rank wildcat areas to the larger companies.

The foregoing statement may appear to be contrary to the facts generally cited, namely, that the small independent does the majority of the wildcatting. Actually, the smaller operators do drill the greatest number of wildcat wells. But on a dollar basis, the large companies spend more proportionately than do the smaller companies.

The major company usually drills the more expensive wildcats, spends more money on exploratory efforts, and supports more wildcatting in new areas by others. The small operator tends to drill the less expensive wildcats, do considerably less geological work on its plays, and in many cases takes in outside equity capital on these ventures.

Diverse Investments. Another difference, growing out of availability of capital, is the opportunity to diversify activities. Today, most large oil companies have diversified their activities within their own general field and continually are seeking further diversification. Besides their production, they have refining facilities, pipe lines, river barges, tankers, etc. Many of them over the past few years have spent considerable sums of money on gasoline plants. The smaller companies also have invested in gasoline plants, but only as they represent a necessary adjunct to producing operations.

Today, all of the larger companies are looking for opportunities to invest in chemical ventures, particularly those chemical ventures where the raw material is oil or gas.

Generally speaking, the small company cannot consider extensive diversification because whatever capital is generated within the small company is required for the maintenance of its primary activity. Sometimes it may not even generate enough capital to maintain its position.

During the past several years, this has happened with small refiners. A number of them have disappeared. The trend probably will continue. Increasing quality requirements have necessitated ever more costly refining methods. Many small refiners simply

are not in a position to meet the tremendous investment needed to maintain and modernize equipment.

Case in Point. There are other differences growing out of the availability of capital. A difference in practice as well as in economic thinking between a large company and small company can be seen in Table 1, embodied in the chart herewith.

Case A is one developed for a major company a few years ago to ascertain the desirability of expanding operations in a certain area. For purposes of this comparison, the amount of money to be expended has been reduced drastically.

Case B was developed a year ago when a small company was considering entering a new area. In both cases it is assumed that no monies are reinvested and that maximum amount of money expended is $100,000. Figures presented are after income tax effects at a rate of 52 percent.

Under Case A, or the major company method, the out-of-pocket position is very substantial for a long time. The ultimate return is much greater. But considering the lesser (discounted) value of future income, the ultimate return realized by the two cases is quite similar. The quality of the figures presented depends primarily on the soundness of the assumptions made. In each case the company involved believed that the factors used correctly portrayed their expectations in the respective areas.

These cases in point do not necessarily reflect the average of financial ventures made by the large and small companies. However, the longer periods of investigation and outlay are generally typical of the large company.

Comparison. From this comparison, it is plain that investment practices of a large and small company may diverge. The large company has the capital to enable it to play the long odds, but in a scientific fashion. The small company is not able to play the game that way.

Their methods might be compared with two men playing roulette. A man with almost limitless financing can afford to play the numbers. He knows that sooner or later one of his bets will pay off big. The man with limited finances will do better to play the red and black.

So, too, with the large and small company. The large company can afford to play for the 36-to-one payoff. The small company, which cannot withstand a long losing streak, will do better to play on even odds.

The large company also can sometimes operate as an investing company and interest itself in ventures where the return to be expected is small but certain. Its investments are many and varied. The rate of return from some is high. Incremental investments at low rates of return benefit the over-all picture.

The small company normally does not have capital that it can allot to ventures where the return is similar to that derivable from stocks and bonds. It must strive to realize a much higher rate of return on every investment.

Acreage Considerations. The large company, again because of availability of capital which enables it to function at times as an investing organization, holds large acreage blocks in widely scattered areas. Generally speaking, it is not urgently concerned with immediate evaluation of this acreage. It knows that sooner or later the area will be tested. The small company must restrict both the size and distribution of its acreage holdings to areas where an early test may be expected.

For this reason, a small company tends to acquire leases immediately prior to, or even after, first development of an area. It depends upon its speed and flexibility to obtain a position in competition with the more affluent large companies.

Power of Decision. Aside from the differences relating to capital availability, there are numerous differences in methods and policy between the two companies. One of the most noticeable is wherein lies the power of making major policy decisions. In the large company, stockholders are important as a whole because of the large amounts of equity capital they have made available. But there their importance ends.

Large sums are expended in maintaining pleasant relations with them and advising them of accomplishments of the company. But normally, no stockholder nor group of stockholders, as such, takes any active part in policy decisions and long-term planning. These functions depend solely upon the board of directors and operating management.

This seems to be true of most of the large corporations. Generally no one stockholder has any significant percentage of the company. About the only time stockholders become vocal is when a proxy fight develops. Even then, when the smoke of battle has cleared away, the company usually is still run by the same directors and the operating management.

In a small company stockholders are much closer to management. Because of smaller size, ownership is generally much closer held. Because of this, certain large stockholders become a part of the management team. They usually participate in major policy decisions as well as long-range planning. This does not, of course, apply to day-to-day decisions. But when major long-term policies are under consideration or deals involving major expenditures the large stockholders are consulted and their consensus prevails.

Thus, in the small company, stockholders are aware of the activities and programs of the company before the fact, while in the large company they seldom know anything about its programs and activities until after consummation.

Decisions of Large Company Slow to Take Form. In the matter of day-to-day management there lies another difference between the large integrated company and the small independent one. The former is largely a committee operation. Its activities are so complex and its holdings so far-flung that no one man can carry the responsibility for making even just the major decisions. This necessitates developing a system for classifying the importance of particular decisions and setting up machinery for deciding. The progress of a proposal through channels can be so slow as to be almost unobservable.

Most major proposals, after slow progress from individual, to supervisor, to department head, to division manager, come eventually for decision before an operating committee or an executive committee. The procedures designed to implement this method must of necessity furnish over-all coverage. This means that they never fit any one situation perfectly. Every venture has its own peculiarities.

Small Company Has Advantage in Making Fast Decisions. On the other hand, the small company exists because of its flexibility and speed. Decisions are not delayed by red tape and ponderous procedures. Usually one man has the authority to say yes or no on the spot. The large company goes hunting with a shotgun; the small one with a rifle. And it is the business of small-company management to see that it does not, with one poorly placed bullet, commit financial suicide.

Even committee decisions in the small company are adapted to the matter at hand and are accomplished quickly. Each man brings out the aspects of a deal that applies to his specialty. The chief officer makes a decision then and there. No reports need be written to other departments. Neither is there need to check whether the expenditure is covered by the budget. There is no need to check tax angles. The men in attendance, besides being expert in a given specialty, are familiar with the over-all position and activities of the company and are well acquainted with all phases of the primary operation.

Large Company Advantage. The large company method has the advantage of permitting groups of specialists to consider each separate phase of a problem or proposal. Presumably, the more individuals considering a problem, the less the probability of error. However, on occasion, a specialist may magnify the importance of a detail out of all proportion to its probable effect on the whole. The small company has the advantage of having men familiar with all phases meeting simultaneously with the chief officer, who immediately can weigh the available facts and reach a decision.

The small company has far fewer specialized departments than the large. But the latter, because of the scope and size of their operations, have need for many specialized departments. There are research, industrial relations, public relations, economics, personnel, stationery, mailing, and many others. In the small company, functions of these specialized departments usually are handled by various personnel in connection with other duties.

Labor Considerations. Labor problems common to the large company are almost nonexistent in the small company, which generally is pretty well ignored by labor unions. The unions' concentration on the larger company brings proportionately greater returns in membership and power.

The small company, by virtue of its size, is much closer to its employes. There is usually less employe dissatisfaction throughout the small company. Duties are more diversified; employes are well acquainted with each other and with management. They know what is going on. They feel that they are a real part of the organization.

The large company's communications is formal and subject to vast improvement. The small company's communications, while not formal, is usually very effective.

Many employes are willing to work for the small company for somewhat less compensation than they might obtain from a larger company. They like the greater variety of their duties and their greater freedom of action. If one is employed in a specialized section of a large organization, the work tends to be repetitive and boring. The employe may lose sight of the importance of his job to the over-all operation.

All companies, both large and small, have tended to take some part in almost every phase of the employes' lives. Most large companies have life insurance plans, retirement plans, and stock benefit plans as do most small companies. But the educational and recreational programs, the coffee rooms, counseling services, and many other so-called benefits, the small company can not afford. To replace these latter, the small company has the closeness to its employes generally lacking in the large company.

Individual Touch. Large and small company economic factors are reflected in still another manner; that which bears upon the philosophy of each and the shareholders of both.

Almost without exception, the large company wants to grow larger or at least maintain its size. The small company forever is striving to grow larger and to expand its economic horizons through extension of those economic factors which govern its status.

To the individual employe, the larger firm usually has its greatest selling point in the security it offers. The small company has recognition, incentive and a challenge to offer. The team-play of the smaller unit in the industry is strong encouragement for the expression of personal ideas. This, in turn, is valued highly by the more progressive employes.

In the field of shareholders, the same basic factors draw participants into the financial structures of both. In the large company, there is long range, stable security without active direction. In the small company, a more flexible schedule of operations per dollar of investment holds definite attractions. This frequently is combined with a close working relationship between investor and management.

Both the large and small companies have their own attractive characteristics. Each is essential to the industry as a whole. —**The End**

About the Author

PAUL R. SCHULTZ became president of the Blackwell Oil and Gas Company, Tulsa, in 1954. He previously was manager of the economics department of Stanolind Oil & Gas Company. Schultz, who joined Stanolind in 1946 as chief chemical engineer, previously was employed by Standard Oil Company (Indiana) in Chicago. He received a B.S. degree from the Illinois Institute of Technology and a master's degree in chemical engineering from the Case School of Applied Science. Schultz is president of the Oklahoma Independent Petroleum Association.

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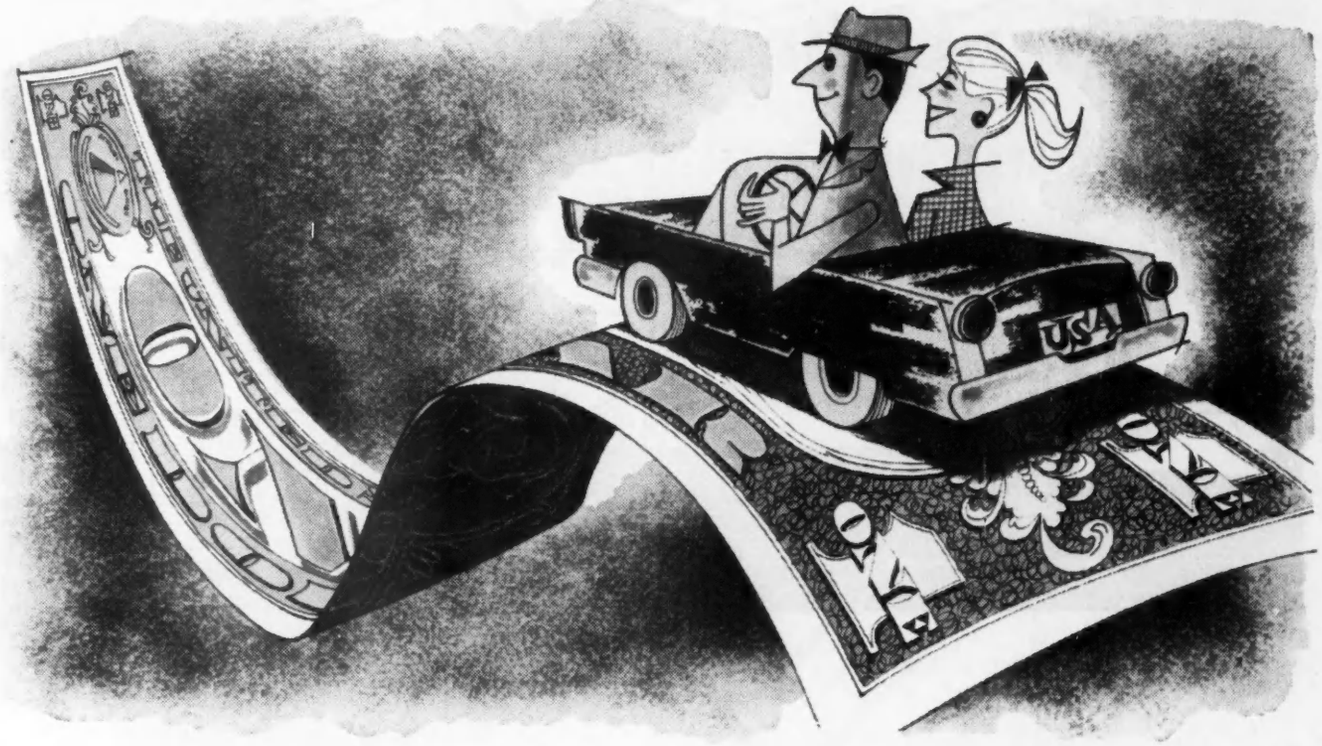
It's surprising how little oil's customers know about the biggest selling petroleum product—gasoline! They never see it or touch it—yet they *use* it every day. All they know is the price they pay . . . and only a few know how big a bargain they really get with today's gasoline.

You'll be helping yourself and your industry by giving oil's customers the *real* story about today's gasoline prices and taxes. Here are the facts:



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It's a fact that the average American motorist actually gets "more for his money" thanks to the bargain he drives with today's gasoline.

In 1920, one dollar bought over 8 pounds of bread, two pounds of pork chops, two pounds of coffee, and over 20 pounds of gasoline.

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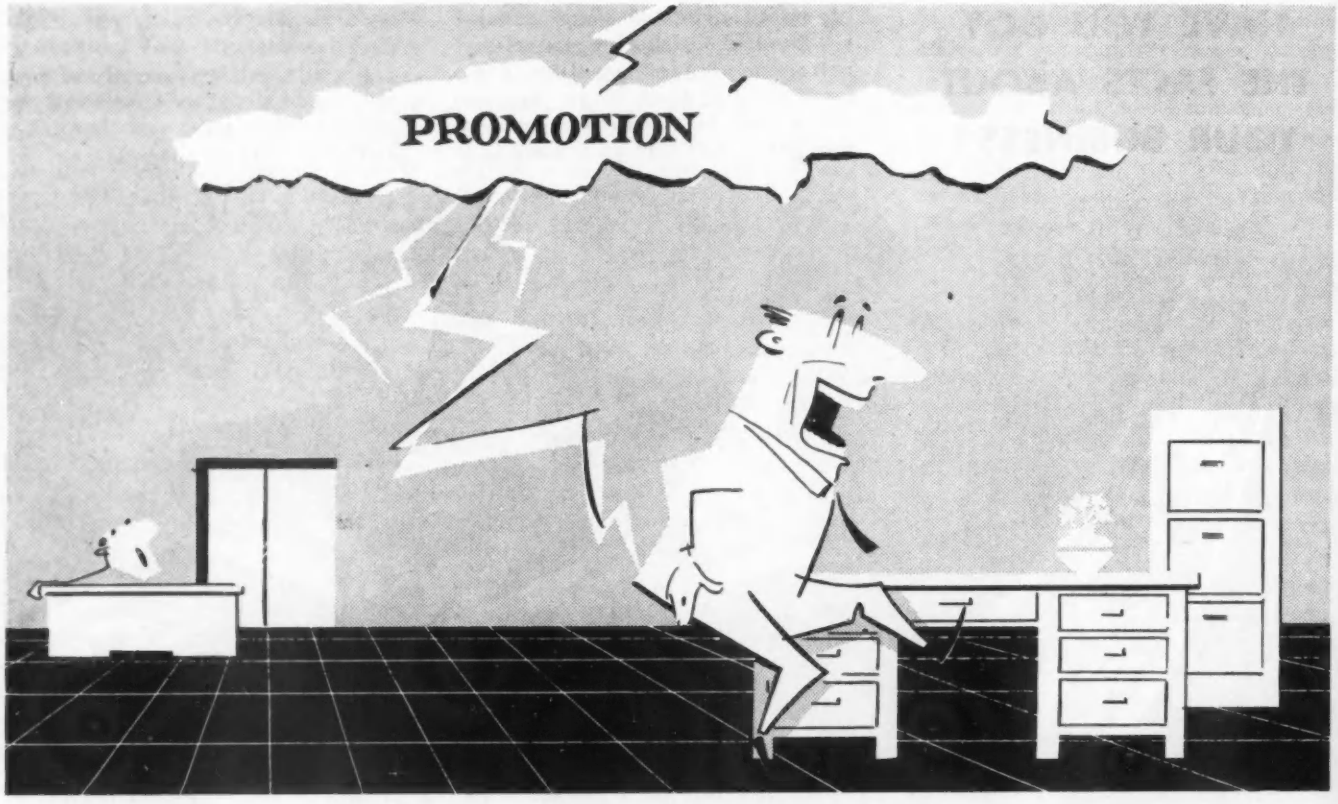

Are You Ready for Promotion?

Here are 50 personal traits most often considered when evaluating employes for promotion. Rate yourself and see whether you are ready for the 'bolt' to strike.

ONE OF THE toughest assignments facing any executive is to decide which one of several employes is to be selected for promotion. Aside from the desire to be as fair as possible he must also be certain that the best possible man from the standpoint of value to the company will be selected.

Here is a method being used by a number of oil company executives. They use a promotion check chart such as that shown in the accompanying illustration. Each factor is balanced for the individual under consideration as to positive possession, uncertainty or failure to possess the desired quality. Two points are scored for those in the first column and one for those in the second (none for the negative checks). The various totals arrived at for each of the employes being checked serve to spotlight the individual possessing the best potential for the new staff position.

Points to be checked vary from one company to another. We have selected herewith 50 of those which appeared most often in a wide number of such lists studied. The reader may use all or any number since different factors will apply to different staff positions under consideration. Keep your own score and see how you rate.

1. Keeps quality of present work exceptionally high day in and day out.
2. Is continually improving his own knowledge of the company operation.
3. Knows what to do in average situations without being told.
4. Has always been willing to share in unpleasant work or unpleasant aspects of the job with other employes.
5. Is good at routine; has shown a knack for following established patterns.
6. Is not fixed in his ways of doing things and has shown willingness to alter previously established methods.
7. Has the ability to learn new methods and shown positive interest in doing so whenever possible.
8. Has demonstrated orderliness in his present work.

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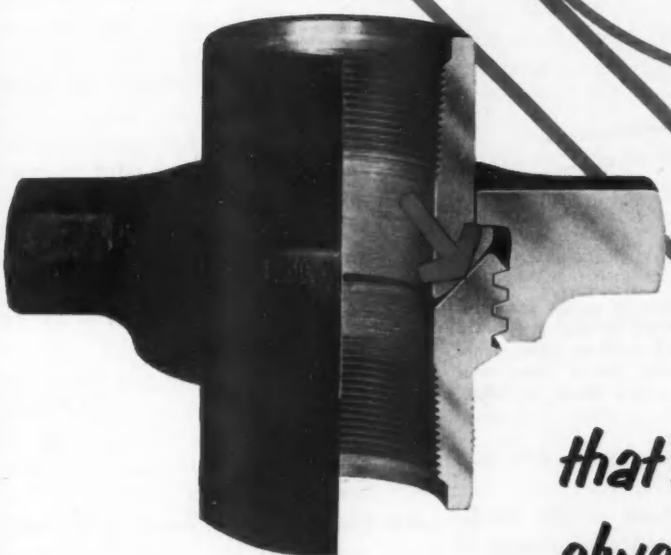

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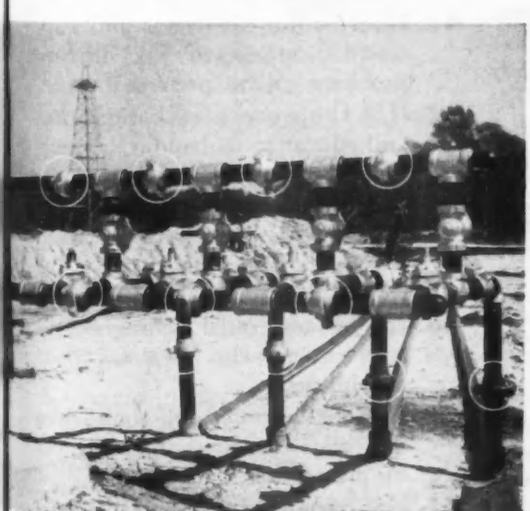

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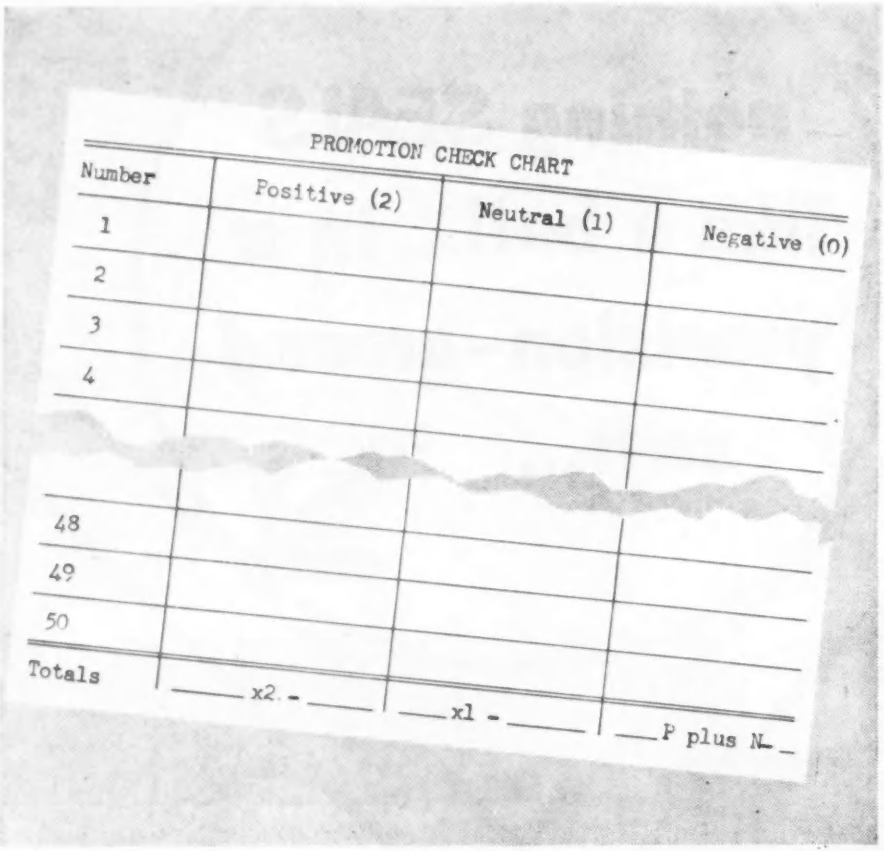


PROMOTION CHECK CHART

Number	Positive (2)	Neutral (1)	Negative (0)
1			
2			
3			
4			
48			
49			
50			
Totals	____ x2 = ____	____ x1 = ____	____ P plus N ____

The above chart may be used in analyzing each individual with respect to points set forth in the accompanying article. The number of lines used will be determined by the number of points applicable. As an example, if all 50 are used and 38 checked positive, that would total 76 in the first column; 10 checked in the second column would give a score total (P Plus N) of 86 since the remaining 12 in the third column would carry no score.

9. Possesses adequate knowledge of details of his present job.

10. Has shown a definite interest in receiving a promotion and wanting to climb in the company organization.

11. Requires a minimum of instruction for any ordinary work assignment.

12. Can think things out—does not need minute detailed explanation of what to do on every assignment.

13. Has shown no inclination to "goof off" at the job now held.

14. Has a good record of past work performance.

15. Takes good care of his personal health in private as well as on the job.

16. Has a record on the present job of a minimum of errors of judgment.

17. Can do every regular assignment without needing close supervision.

18. Does not give alibis or excuses for failure to do his work.

19. Has a general attitude of cheerfulness at his present job and around others.

20. Shows seriousness at his work; has demonstrated a minimum of "horse play."

21. Can do his present job without physical or mental strain.

22. Demonstrates patience with others in connection with his work; both those above him and at his own level in the organization.

23. Is able to pro-rate his energies throughout the day and keep at top efficiency all through.

24. Has demonstrated a positive interest in the oil business in the past.

25. Has demonstrated loyalty to the company in the past.

26. Knows how to get along with supervisors in his present job.

27. Possesses the ability to concentrate on a given problem and solve it effectively in a minimum of time.

28. Seeks and does additional tasks connected with his job without their being assigned directly to him.

29. Is respected by the men and women with whom he has worked.

30. Can stand criticism from superiors as well as fellow employes without being hurt or showing resentment.

31. Is usually pleasant and cheerful as a natural personality trait.

32. Willingly conforms to the rules set for employe conduct.

33. Does not become flustered or embarrassed easily.

34. Has personal long range plans for his career and has worked toward them in the past.

35. He can take criticism given to him and show profit thereby following such criticism.

36. Is willing to accept responsibility when things go wrong on the job.

37. Has pleasant personal habits and traits.

38. Is settled in his personal life away from the job and in relationships with others.

39. Is able to work with and get along with both sexes among employes.

40. Has no fixed prejudices in his personal thinking.

41. Has learned all of the basic fundamentals of his present job and shows possibility of doing so easily on the job under consideration.

42. Has full appreciation of the principle that the company must make a profit and how it is done.

43. Lives within his means and successfully manages his money problems on his present income.

44. Has the necessary background and education to handle the next step up the ladder.

45. Has developed good outside interests in his life to offset any job tensions which develop in his work.

46. Has demonstrated willingness to help others who lack his own capabilities.

47. Has demonstrated self confidence and assurance both on and off his present job.

48. Has refrained from obvious apple polishing; a sign of personally admitted shortcomings.

49. Has expressed confidence in the firm as being a fine company.

50. Has shown no signs of unstableness in political or economic thinking in the past.—**The End**

Improve Your Writing Skill

If you want to produce good writing efficiently, adopt the methods of the professional.

By John L. Kent
Consolidated Electrodynamics Corporation, Pasadena, Calif.

EDITORS COMPLAIN that engineers don't know how to write for their readers. Research directors and other company administrators complain that their engineers write poor reports.

Yet, technical writing can be improved easily. Special courses at industrial firms and in government laboratories have proved that.

The engineer's inability is chiefly due to a lack of knowledge. Unfortunately, this knowledge is not readily available. Refresher courses are few, and the several textbooks are long on theory and short on practical help.

Engineers' training and experience help them become good writers faster, but at the same time throw a number of hazards in their paths.

First of all, because they are used to doing things systematically, engineers do not have too much trouble organizing their written presentation. On the other hand, because they are detailists, they often include all the details, failing to weigh their relative importance for the purpose of the report or article.

Engineers deal with facts and things. They therefore find it easy to write their reports and articles unemotionally and without bias. But because of this objectivity, they also find it difficult to engage in the "light touch" that is often necessary to explain difficult passages.

Learn the "Professional" Touch. Generally, the engineer-writer succeeds almost directly in proportion to his adoption of methods used by professional writers.

The professional writer—the man who earns his bread by his writing skill—must have somehow acquired techniques which serve his purpose. And, of course, he has. These methods are adaptable to technical writing. They can be summed up under four headings:

1. Plan and outline.
2. Consider the reader.
3. Use short sentences and simple words.
4. Be critical.

Planning Is the First Key. The first, and most important key is proper planning. Whether it's an article, report or other technical manuscript, an outline and a period of planning are necessary. Write an outline.

Every type of writing has its own outline—its writing format.

A report, for example, is a specialized form of expository writing whose order should be apparent through section headings, sub-headings, numbered paragraphs and other means.

An article, too, has a form. It is not a cutdown report. It's a distinct piece of writing.

A technical article does not have to be as complete and as detailed as a report. You can omit details of minor importance. This "selective omission" is one of the major differences between the report and the article. A technical article will have a more general audience which will include many "non-specialists." This means that you will have to broaden your appeals somewhat.

The detailed planning should not be hurried. Professional writers point out that after making an outline, the writer should temporarily forget about

Checklist for Technical Reports

Experienced writers have learned that they could find errors and flaws in their writing and presentation only by using a checklist and systematically going through their manuscript several times. Here is one for checking reports.

1. First consider the report as a whole
- a. Are the various parts labeled properly?
- b. Is there evidence of orderly presentation?
- c. Does report tell a story?

2. Introduction
- a. Does introduction agree with other parts of report?
- b. Have you told reader what you will tell him in report?

3. Body of report
- a. Have you described methods or operations completely?
- b. Are details clear enough so another person can reproduce work?

4. Check conclusions and recommendations
- a. Do they answer the problem posed in introduction?
- b. Are recommendations clear? Do they avoid hedging?

5. Composition
- a. Have you clearly marked transitions from one topic to another?
- b. Check paragraphing.
- c. Check sentence structure.
- d. Check words. Strike out and substitute better ones where needed.

6. Grammar
- a. Look for split verbs, poorly placed adverbs.
- b. Check "and" and substitute better conjunction where possible.

7. Read report again
- a. Are there any weak spots which are not clear?
- b. Consider the reader. Will he understand everything you said?

the writing and go on to something else. It is important that you do not write the report or article after your mind is apparently primed for it.

A lapse of even a few hours will help produce better written work. During this unproductive time, your subconscious will be working on the article or report. Finally, when you sit down to write, you will find it much easier than you anticipated.

Consider the Reader. The second key to technical writing improvement is to consider the reader. To write well, you must consider your typical reader and write for him.

Who is your typical reader? It is probably another engineer or some technically trained person. This type of person possesses certain characteristics.

First of all, he is a serious person who is reading your material solely to get information. He is not interested in being entertained. A trade journal editor knows this, so in an article you submit he cuts any cute openings or obscure analogies you might have dreamed up.

Because of his education and experience, the technical reader is orderly and neat. He thinks more logically than most of us. Thus he wants to see some semblance of order in your presentation. You can please him by stating your information in some logical manner—chronological, for example. Or, proceeding from the general to the particular. In a report this order is apparent through use of section and subsection headings.

Lastly, your reader is a busy man. In most industrial fields the engineer is pacing progress. So you must use the least amount of his time to tell your story. The editor knows this too, and he acts accordingly. If you haven't taken the engineer's time into consideration, he will. And your story will be cut.

So these are the things you must do:

1. Write for a specific audience—Unless you keep your typical reader in mind as you write, you will not write at the proper level. In engineering writing the tendency is to assume a greater stock of knowledge than the typical reader possesses.

2. Give reader information — He wants to read solely for information. Not for entertainment. Not to kill time.

3. Tell your story quickly — Give him summary-type reports. Write articles with newspaper-style leads. Don't dramatize — summarize. Don't expand—condense.

4. Make your story easy to read—Two easy ways of making your story easy to read: Use short words. Use short sentences.

5. Be clear, concise—Clear writing can be obtained chiefly through simplicity and precision. Keep thoughts (and resulting sentences) simple. Conciseness can be obtained by planning and outlining and by the use of simple grammatical construction.

6. See it from reader's viewpoint—Who cares what you think! It's your reader, not you, who is important. Look at your story from his self-interest.

Use Short Sentences. One of the major "tricks of the trade" of the professional writer is his use of short sentences. The professional writer also uses the short word in preference to the long one.

The short sentence is probably the greatest help to understandable writing. It permits spacing of ideas.

As sentences become longer, relationships between words become less clear. Such sentences are harder to understand and may require rereading. They often lead to errors in grammar.

There's another reason why technical people in particular should write short sentences. In ordinary writing, shorter words can be substituted to help the reader understand. Generally, technical words cannot be simplified. Short sentences can compensate for this limitation.

When average length of sentences runs over 20 words, thoughts become difficult to understand.

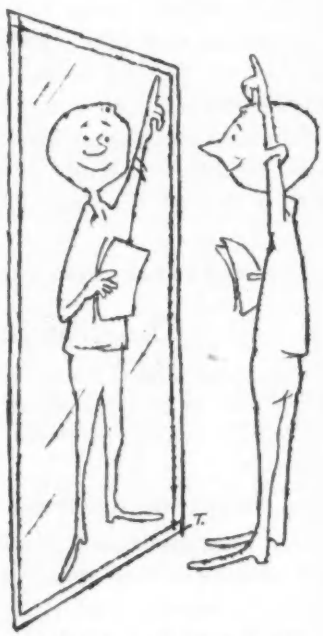
A sentence of over 25 words generally can be put into two short ones. After several long sentences, insert a short one to act as a "rest" for the reader's mind.

Be Critical. Being critical of our writing is the fourth key to good presentation. This involves more than a mere reading over and insertion of a comma or the substitution of a better word. It should be a systematic check of the manuscript.

After you have written your first draft, read it over several times to get the feel of it. Are you telling a story? Simply? Concisely?

Read it over again, with a good

"The detailed planning should not be hurried."



"Who is your typical reader?"

"Be critical."

we can show you the forest because of the trees

Many times oil men feel they are in a poor position financially simply because they can't see the entire picture of their operations. Caught in the complexities of their day-to-day activities, they are unable to survey their properties in a realistic, objective manner. And as a result, many times they end up working for their creditors.

Increased operating costs spell falling profits. And that means trouble. While there is no short cut way out of this problem, The Commerce working with your legal and tax counsel can many times show you how to increase profit by reducing costs. Tighter managerial control, an analysis of costs, and recommendations for changes have increased the profit of other oil men. If your problems are similar, come to the bank that actually does know the oil business and that can help you.

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dictionary at hand, and look for bad sentences, lack of topic sentences and errors in grammar. If time permits put the manuscript out of sight for a day or two. Then read it over again before letting it out of your hands as finished writing.

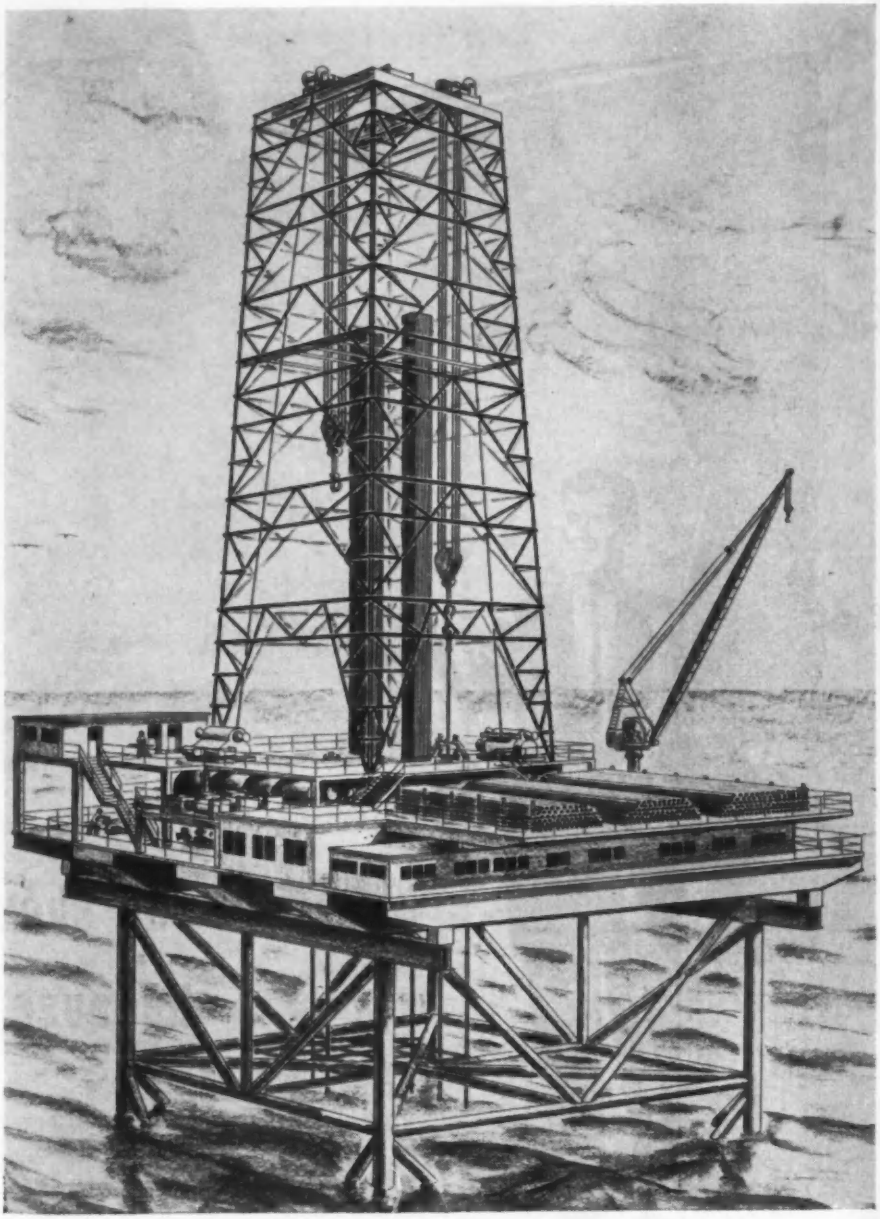
Examinations of engineers' writing reveals several failings which are repeated over and over. These include failure to paragraph, use of jargon and cliches, wordiness, and lack of "sell."

The first sentence of a good paragraph should be the topic sentence. It should tell the reader what's going to be said in the paragraph. It should also provide a transition (if such is needed) from the preceding paragraph. This topic sentence should be short and direct.

You Must "Sell" Your Story. The lack of "sell"—the ability to "put over" a story — is evident in both articles and reports. Many articles in trade journals are uninspired and uninspiring.

To get good presentation you must not only get facts down briefly, but so arrange them that the reader can sense that back of the arrangement and presentation was an engineer who knew what he was talking about.

Directness, simplicity and enthusiasm help put over articles, reports and bulletins. People respect a man who knows where he is going. This is also true for a piece of writing.



Artist's sketch of the $2 million drilling platform to be constructed by Standard Oil Company of California on the state's offshore oil lease near Summerland, Calif. The structure will have a 110-foot square deck, stand 50 feet above the water line, and be topped by a 140-foot derrick during drilling operations. It will be capable of drilling two wells simultaneously, and up to a total of 25 wells from the same location. It's the first such structure to be erected under the state's program for oil development on certain of its offshore lands.

Two Wells at a Time to Drill at California Offshore Site

LATEST DEVELOPMENT in California offshore operations is a $2 million 25-well capacity platform designed to permit the simultaneous drilling of two wells under the same derrick. Site for the unit is to be in 100 feet of water 2.2 miles off Summerland, California, between Ventura and Santa Barbara.

The unit, to be built by Standard Oil Company of California for use on a jointly-owned lease with Humble Oil & Refining Company, will become a permanent production platform when drilling operations are concluded.

Construction is scheduled to commence next year.

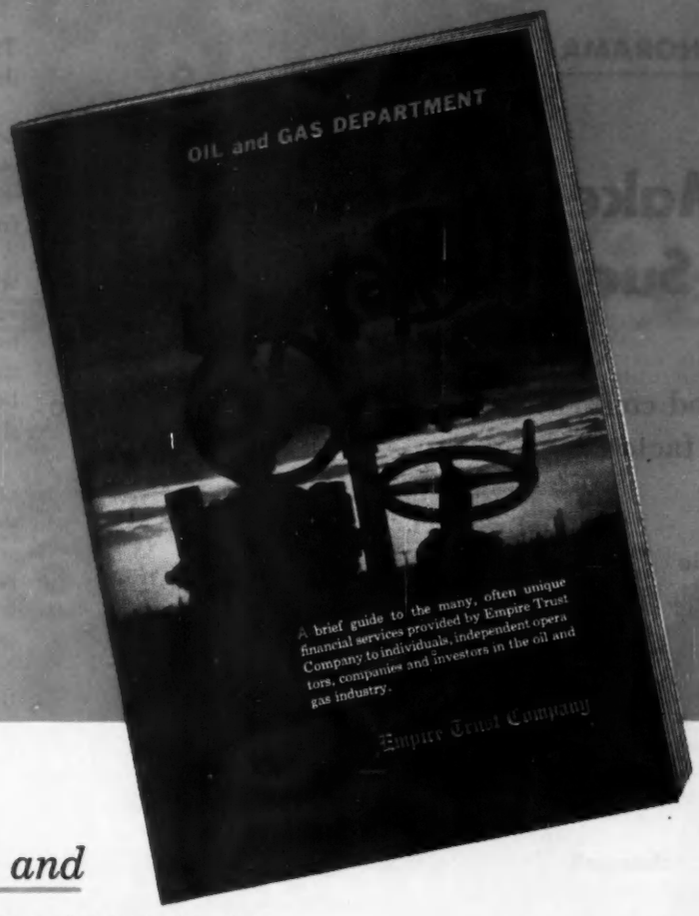
The lease was acquired last January on a bid of $7.5 million. A few months ago the operators completed an exploratory hole drilling program on the lease from a mobile offshore platform.

About the Author

John L. Kent is chief of the Editorial Bureau of Consolidated Electrodynamics Corporation, Pasadena, Calif. During his career he has been a government information officer, trade journal editor, and company periodical and manual writer and editor.

Kent is president of the Technical Writing Improvement Society, and is a member of the American Association for the Advancement of Science, and other professional groups.

this booklet tells...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What Makes Contract Drilling Successful

Good company-contractor relationship can be traced to these factors.

By Bart W. Gillespie
Oilwell Operators, Ltd., Calgary

ONE OF THE most significant changes in drilling approach has been the decline of company-operated rigs and the almost universal acceptance of specialists in the contract drilling business.

What caused this change? The writer can think of six important factors. There may be many more.

1. No large oil company with a diversified program wants to inventory the various rig sizes required to meet the different depths encountered in covering exploration and development drilling in widely-separated parts of the country.

2. No small company can afford to purchase a rig for exploring unknown prospects with only a limited use for such a rig.

3. No company cares to employ good men for big programs and then have to release them when activities slacken off.

4. Most companies select contractors because they recognize that the particular contractors have become familiar with the drilling problems of an area and should be in a position to produce results.

5. Drilling has become increasingly specialized, and the successful drilling contractor combines engineering brains with sound practical thinking to get results.

6. The economy of tying up capital in a huge drilling inventory where equipment lies idle is unsound. The very nature of contract drilling points towards the drilling contractor keeping his equipment busy more days per year than could an operator.

Success or Failure? What makes a contractor a success or failure, exclusive of drilling slumps and other acts of God? This is too broad a subject to cover in a few words, but the following observations have a strong bearing on the question:

1. The case of bidding low to break into a company, unless a break-even point is calculated and the contractor had no bad luck, may cause losses impossible to recover.

2. (a) The case of bidding without accurate and complete information. At times the information provided by a company is inaccurate or incomplete. Under such circumstances, some companies will reconsider renegotiating their agreements. (b) In many instances, incomplete information is evidence of carelessness on the part of the contractor, in which case the contractor usually loses.

3. The case of bidding based on financial considerations. Where notes must be met, a contractor may go beyond a safety point and may be suspected of having financed his business unwisely. Such agreements are rarely renegotiable.

4. The case of an honest bid based on the only information available. This case should be renegotiable providing the contractor has shown good judgment in his work.

Inaccurate bids, which stem from insufficient information or from a clear-cut understanding of what a company expects of a drilling contractor, indicate the need to work out a standard form of inquiry relating to wells to be drilled. Some operators are still working on such forms. The common denominator for all bidders has not yet been found.

Several unusual clauses have appeared in agreements made between operators and drilling contractors. Two clauses which may lead to confusion are the mud and chert clauses.

Mud clauses are those which apply where new muds appear on the market which are considered to speed up hole-making. Some basis for agreement should be worked out whereby better speeds are attained without endangering hole conditions.

Chert clauses are confusing, since chert is not the only material which dulls bits. It is difficult to ascertain what percent of chert present in a hole should apply in relieving a contractor of his responsibility. There are instances where some relief should be given a contractor—but what are they?

Contracts on per-day basis. Many companies don't care any more for this type contract than they do for a cost-plus agreement. However, such contracts are a must in many foreign operations and in isolated wildcat drilling. In these instances most of the risk is transferred to companies and therefore, they demand the highest performance on the part of the drilling contractor. Such contracts go to those in whom companies have great confidence. The big burden in this case, on the contractor's part, is excellent equipment and experienced personnel.

Operations come next. The best contractor/company relationship is based on:

1. A clear definition of objectives.

2. A straight chain of command.

3. A sound observation of safety rules.

4. A respect for a company's security rules.

5. Hole protection as exemplified by blowout regulations and proper hole conditions to permit testing, fishing, etc.

6. Hole deviations; under what conditions can they be relaxed?

Standardization of hole sizes, tools, drill pipe, casing, and tool joints, has been achieved through the efforts of standardization committees of various industry organizations. Contractors now have streamlined equipment, reduced inventory, and come up with a clearer program. —**The End**

when you must be SURE

... that a zone, or a section of casing is positively isolated, set a ...

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BAKER OIL TOOLS, INC., / HOUSTON / LOS ANGELES / NEW YORK

By Ray L. Dudley, Publisher, and **Warren L. Baker,** Editorial Director

Outlook Should Improve in October

Reduction of U. S. production to two-year low and prospects for less imports promise substantial improvement in surplus crude stocks during October.

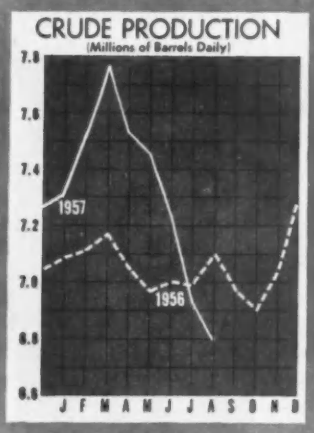
Difficult times still face U. S. crude producers, but prospects are improving for some relief during the closing months of 1957.

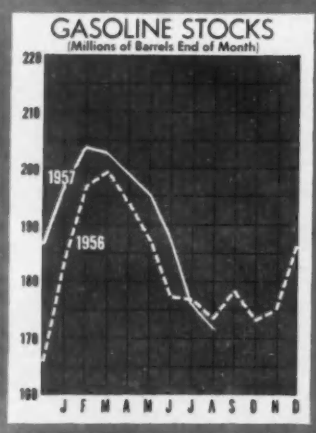
The industry is making a strenuous effort to get its affairs in shape. Domestic crude production will be further curtailed in October, dipping to a two-year low. Schedules filed with the government import administrator promise a reduction in crude imports.

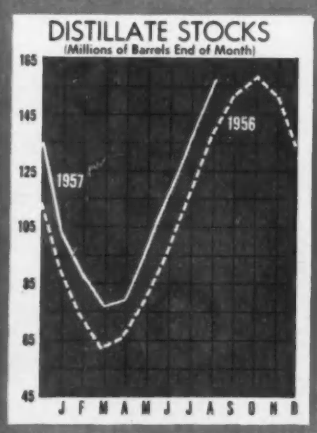
These programs should result in real strides in the reduction of surplus crude oil inventories during October. They should put the industry in a position where it can benefit from higher winter demand. Therefore, October may be the low adjustment period for U. S. producers.

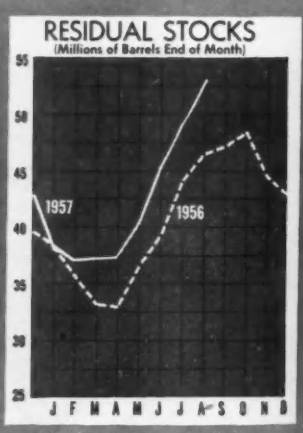
The degree to which future months relieve U. S. producers from recent drastic curtailment will depend on demand and imports. A big factor in bringing about the current crisis was

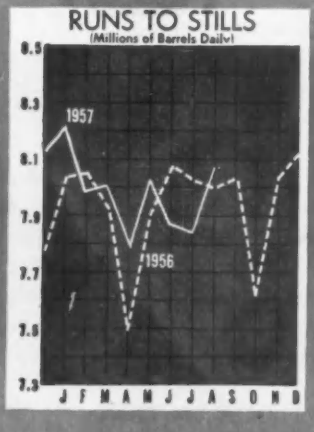
Petroleum Trends . . .

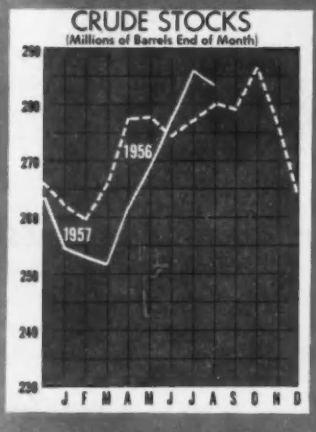


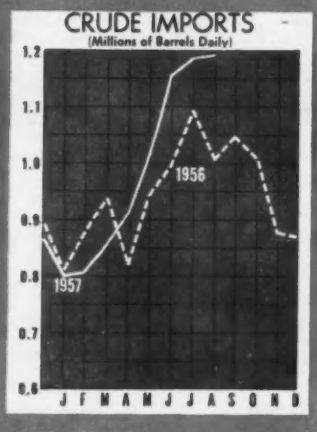


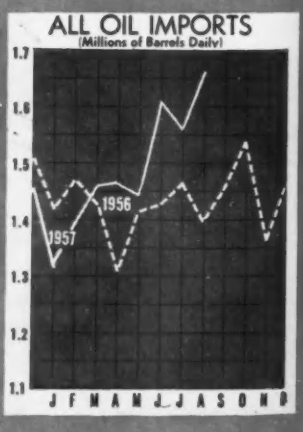












the failure of summer demand to come up to expectations. It averaged around 300,000 barrels per day less than generally anticipated. Colder than normal weather in the Midwest and upper Atlantic Seaboard would help enormously.

Relief from current conditions is sorely needed by U. S. producers. Production has been cut so drastically, October output will be one million barrels per day less than last February and March. While this two-year low obviously will work a severe hardship on U. S. producers, the reduction gives hope that substantial improvement will result in crude oil inventories.

Texas wells will be permitted to produce only 12 days during October, an all-time low. Oklahoma and New Mexico wells are limited to a maximum of 20 barrels and 37 barrels a day respectively. Any step, however drastic, that will bring relief to these conditions is vital.

Reduced output in October should go a long way toward curing excess crude oil inventories. Stocks of crude oil totaled 282 million barrels on September 13, or 35 million barrels above inventories the end of last March. If 10 million barrels of crude can be taken from storage, much of the surplus will have been removed.

Hopes that October will see a substantial reduction in surplus crude oil supplies is heightened by prospects crude imports may be smaller. Importing companies have indicated they expect October crude imports, exclusive of the West Coast, to average 790,000 barrels daily, 200,000 barrels less than in August.

High distillate stocks will dampen the favorable influence of higher demand on crude oil markets. Distillate fuel inventories rose to an all-time peak of 162.8 million barrels on September 13, up 1.2 million from the previous record of early November, 1956. The current level is 16.7 million barrels greater than a year ago, with 13.0 million of the increase located outside the West Coast.

Steps must be taken to curb the growth of distillate fuel stocks. Hence higher winter demand should not result in an immediate sharp increase in crude oil runs to refineries. A wiser course would be to let colder weather absorb some of the surplus fuel inventories.

Very cold weather in the north and northeast parts of the country would be very beneficial. Producers might then anticipate considerable relief from recent low producing rates. On the other hand, warmer than normal weather would decrease the market for domestic crude oil.

U. S. Crude Production by States
(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL PRODUCTION FIRST EIGHT MONTHS		
	August, 1957	July 1957	August, 1956	% Diff. 1957-1956	1957	1956	% Diff. 1957-1956
Alabama	14.2	13.2	10.8	+ 31.5	3,370	1,753	+ 92.2
Arkansas	84.1	84.5	80.5	+ 4.5	20,618	19,222	+ 7.6
California	925.3	930.8	959.1	— 3.5	226,154	235,490	— 4.0
Colorado	149.9	151.9	156.3	— 4.1	37,372	39,346	— 5.0
Florida	1.2	1.3	1.3	— 7.7	308	325	— 5.2
Illinois	166.7	158.1	225.5	— 26.1	48,335	54,850	— 11.9
Indiana	29.1	28.1	29.0	+ 0.3	8,330	7,169	+ 16.2
Kansas	340.2	338.6	347.6	— 2.1	81,087	83,409	— 2.8
Kentucky	39.6	39.1	47.4	— 16.5	10,818	11,677	— 7.4
Louisiana	796.8	867.4	787.0	+ 1.2	225,450	195,465	+ 15.3
North Louisiana	125.8	129.2	126.7	— 0.7	32,428	30,978	+ 4.7
South Louisiana	671.0	738.2	660.3	+ 1.6	193,022	164,487	+ 17.3
Michigan	27.5	27.5	29.6	— 7.1	6,830	7,354	— 7.1
Mississippi	108.0	117.0	110.0	— 1.8	27,467	26,983	+ 1.8
Missouri	0.1	0.1	0.1	.....	41	42	— 2.4
Montana	75.1	74.1	58.4	+ 28.6	17,708	13,980	+ 26.7
Nebraska	54.9	52.2	44.2	+ 24.2	12,345	10,456	+ 18.1
Nevada	0.1	0.1	0.2	— 50.0	21	47	— 55.3
New Mexico	249.2	254.1	239.1	+ 4.2	62,894	58,029	+ 8.4
Southeast New Mexico	244.7	249.6	233.8	+ 4.2	61,536	57,127	+ 7.7
Northwest New Mexico	4.5	4.5	4.3	+ 4.7	1,358	902	+ 50.6
New York	7.5	7.2	7.7	— 2.6	1,799	1,840	— 2.2
North Dakota	37.5	38.6	38.6	— 2.9	9,518	8,908	+ 6.8
Ohio	15.3	16.6	13.7	+ 11.7	3,478	3,131	+ 11.1
Oklahoma	555.1	571.8	580.8	— 4.4	145,831	144,776	+ 0.7
Pennsylvania	23.8	22.6	23.3	+ 2.1	5,616	5,488	+ 2.3
South Daketa	0.2	0.2	0.1	+100.0	23	21	+ 9.5
Tennessee	0.1	0.1	0.1	.....	6	6	.....
Texas	2,790.2	2,803.5	3,098.6	— 10.0	751,020	744,517	+ 0.9
Dist. 1: South Central	51.0	52.5	56.4	— 9.6	13,394	13,240	+ 1.2
Dist. 2: Middle Gulf	133.3	134.6	153.3	— 13.1	37,203	38,410	— 3.2
Dist. 3: Upper Gulf	425.7	426.3	457.9	— 7.0	110,924	111,144	— 0.2
Dist. 4: Lower Gulf	214.4	216.6	244.4	— 12.3	57,435	59,820	— 4.0
Dist. 5: East Central	35.9	36.4	43.3	— 17.1	9,767	11,093	— 12.0
Dist. 6: Northeast	298.5	302.1	340.1	— 12.2	82,756	84,295	— 1.8
Dist. 7-B: North Central	150.2	151.6	158.0	— 4.9	39,561	38,104	+ 3.8
Dist. 7-C: West Central	145.5	144.2	193.1	— 24.7	40,278	45,371	— 11.2
Dist. 8: West	1,026.1	1,031.9	1,060.2	— 3.2	277,968	255,338	+ 8.9
Dist. 9: North	203.0	201.9	217.1	— 6.5	51,322	51,497	— 0.3
Dist. 10: Panhandle	106.6	105.5	100.1	+ 6.5	25,535	23,225	+ 9.9
Utah	10.9	10.7	8.8	+ 23.9	2,474	1,345	+ 83.9
Virginia	0.1	0.1	.....	.....	9	7	+ 28.6
West Virginia	6.1	6.1	6.2	— 1.6	1,453	1,473	— 1.4
Wyoning	290.7	291.7	290.0	+ 0.2	70,868	69,913	+ 1.4
Total United States	6,799.5	6,907.3	7,194.0	— 5.5	1,781,243	1,747,022	+ 2.0

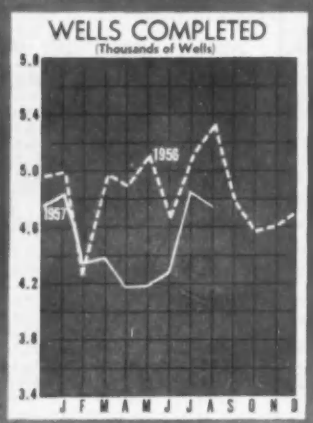
Source: Bureau of Mines and API. Texas Districts from API and do not necessarily agree with State total.

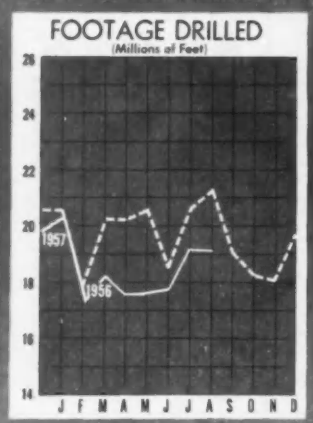
U. S. Crude Oil and Refined Product Trends
(THOUSANDS OF BARRELS)

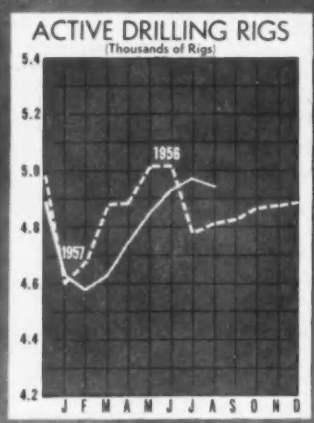
MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1955:											
December	7,155	7,762	265,610	3,916	165,433	1,765	111,333	1,286	39,174	884	1,502
1956:											
February	7,208	8,047	259,504	3,854	196,092	1,918	71,335	1,286	35,673	878	1,472
March	7,278	7,914	265,683	3,829	199,698	1,808	60,846	1,213	32,984	934	1,425
April	7,146	7,487	277,121	3,646	193,299	1,713	63,571	1,130	32,740	815	1,305
May	7,064	7,896	277,497	3,859	186,673	1,667	75,928	1,149	36,607	938	1,416
June	7,100	8,071	274,491	3,976	177,076	1,755	93,758	1,098	39,073	987	1,426
July	7,090	8,014	277,008	3,975	176,536	1,767	115,787	1,066	43,958	1,084	1,463
August	7,195	7,995	279,944	4,037	172,939	1,839	137,905	1,091	46,617	1,001	1,399
September	7,054	8,024	278,791	3,991	177,974	1,845	150,411	1,062	47,342	1,043	1,452
October	6,966	7,608	286,560	3,773	172,798	1,772	158,871	1,082	48,400	1,004	1,541
November	7,139	8,031	275,995	3,913	174,808	1,841	151,517	1,182	44,590	871	1,362
December	7,377	8,141	266,014	4,039	187,271	1,981	133,981	1,288	44,491	873	1,471
1957:											
January	7,480	8,274	256,669	3,991	197,702	2,118	100,572	1,322	38,403	805	1,421
February	7,682	8,088	256,344	3,864	205,270	2,035	85,105	1,270	36,201	780	1,430
March	7,717	8,047	254,911	3,826	206,716	1,861	76,245	1,205	37,371	836	1,464
April	7,541	7,740	265,796	3,770	201,407	1,764	78,743	1,132	37,429	906	1,542
May	7,442	7,992	275,963	3,900	194,770	1,789	98,135	1,103	41,125	1,042	1,558
June	7,107	7,867	284,312	3,984	177,997	1,773	117,364	1,101	45,572	1,147	1,606
July	6,907	7,850	285,656	3,812	175,952	1,749	137,600	1,095	49,082	1,188	1,556
August	6,799	8,077	283,974	3,997	172,217	1,793	156,307	1,102	52,914	1,191	1,666
Week Ended:											
9-13-57	6,821	8,056	282,096	4,078	173,805	1,768	162,853	1,106	55,183	968	1,332
9-14-56	6,936	8,078	275,253	3,932	175,767	1,809	146,105	1,107	48,276	1,101	1,494

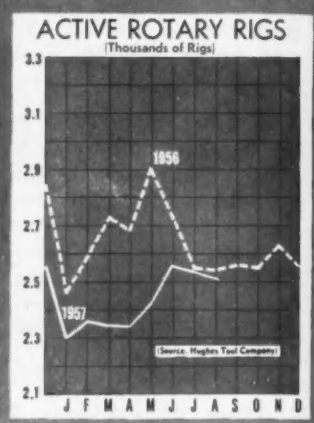
Source: Data for last two months from API; prior monthly data from Bureau of Mines.

Drilling Activities . . .









August Wells Off Slightly, But Upward Trend Expected

By Cecil W. Smith
World Oil Staff

The number of new U. S. wells completed in August did not quite measure up to the year's high mark set in July, but the difference was not great, and the final four months should see activity at least on a par with the comparable period of 1956.

That does not mean that a great surge of drilling is expected, but it does appear that the current rate can be held and perhaps even bettered. The favorable comparison with last year's final months will be the result of the sharp slackening that started in September, 1956, and continued for the remainder of the period. The easing that occurred then was the direct result of pipe shortages that came from earlier steel industry labor strikes.

When the tubular goods situation was alleviated, other factors took over to continue the depressing force on the nation's drilling program. The most powerful of these forces is the supplanting of domestic oil production with imports of foreign oils. Regulatory bodies of the principal oil producing states are having to curtail producing rates in the interest of waste prevention. The 12 allowable producing days set for October in Texas is the lowest in that state's history. The situation has not been helped by the failure of the nation to consume oil products at expected rates. Domestic demand for oils this year is expected to top 1956's by only 2 percent, instead of the earlier anticipated 5 percent.

Despite the problems, the industry completed 4753 new wells during August, 92 fewer than was recorded in July. Although those 4753 wells were twice the number drilled per month in many earlier years, they failed by 585 of matching the 5338 completed in August, 1956, which was the top period of that year.

In the first eight months, a total of 35,674 wells was drilled. That was 3739 wells, or 9.5 percent, less than the 39,413 count at the same time last year. The year's record lost a little ground in comparison with 1956, as the difference had amounted to only 9.2 percent at the end of seven months, but the remaining four months should see a more favorable comparison develop.

Tempering the decline in wells somewhat has been the greater depth to which this year's wells have been drilled. While total footage drilled has trailed 1956's by 8.1 percent, the average depth of each well has been calculated at 4123 feet. A year earlier, this average had amounted to 4057 feet, or 66 feet less for each well drilled.

Summary of U. S. Drilling Activity

ITEM	Aug. 1957	July 1957	EIGHT MONTHS January-August 1957	1956	Percent Diff.
New Wells Completed:					
Oil	2,427	2,475	18,706	21,019	—11.0
Distillate	77	70	470	385	+22.1
Gas	302	324	2,406	2,625	— 8.4
Service	89	115	698	615	+13.5
Dry	1,858	1,861	13,394	14,769	— 9.3
Total Wells	4,753	4,845	35,674	39,413	— 9.5
Footage Drilled (Mln. of Feet)	19.2	19.3	147.0	159.9	— 8.1

Summary of U. S. Wildcat Drilling

ITEM	Aug. 1957	July 1957	EIGHT MONTHS January-August 1957	1956	Percent Diff.
New Field Discoveries:					
Oil	82	73	554	732	—24.3
Distillate	13	6	83	76	+ 9.2
Gas	21	14	150	153	— 2.0
Total Discoveries	116	93	787	961	—18.1
Dry Wildcats	877	928	6,771	7,396	— 8.5
Total Wildcats	993	1,021	7,558	8,357	— 9.6
Percent Productive	11.7	9.1	10.4	11.5	.....
Percent Dry	88.3	90.9	89.6	88.5	.....

U. S. Drilling Activity in August and First Eight Months, 1957-1956

STATE or DISTRICT	TOTAL NEW WELLS COMPLETED AND FOOTAGE DRILLED: DETAILS FOR AUGUST, 1957 — Oil	Dist.	Gas	Dry	Service Wells	TOTAL NEW WELLS — Aug. 1957	July 1957	Aug. 1956	Total Footage August 1957	DETAILS FOR JANUARY-AUGUST — NEW WELLS — 1957	1956	Percent Diff.	FOOTAGE — 1957	1956	WILDCAT DRILLING IN AUGUST AND FIRST EIGHT MONTHS, 1957-1956: DETAILS FOR AUGUST, 1957 — Oil	Dist.	Gas	Dry	Total Wildcats	DETAILS FOR JANUARY-AUGUST — Oil	Dist.	Gas	Dry	TOTAL WILDCATS — 1957	1956	DRILLING RIGS IN OPERATION — Aug. 31 1957	July 31 1957	Aug. 31 1956
Alabama	2	....	....	2	....	4	5	7	25,616	71	63	+ 12.7	613,827	512,565	....	....	....	2	2	....	....	1	25	26	19	8	7	14
Arizona	....	....	....	1	....	1	1	3	2,303	2	7	— 71.4	4,505	22,048	....	....	....	1	1	....	....	....	2	2	7	5	4	1
Arkansas	86	....	2	35	....	123	109	100	357,667	739	598	+ 23.6	2,206,267	1,852,075	4	....	....	13	17	8	....	....	102	110	98	69	64	67
California	128	....	7	47	....	182	176	200	791,277	1,447	1,445	+ 0.1	6,179,401	6,778,687	1	....	....	28	29	6	....	3	234	243	181	178	177	194
Colorado	14	....	5	46	....	65	66	98	334,617	533	848	— 37.2	2,775,902	4,418,063	3	....	1	36	40	15	1	8	302	326	432	66	65	79
Florida	....	....	....	....	....	....	2	1	.....	8	8	.....	57,082	43,137	....	....	....	....	....	....	....	....	8	8	8	....	1	2
Georgia	....	....	....	....	....	....	....	....	.....	3	5	— 40.0	18,955	22,008	....	....	....	....	....	....	....	....	3	3	5	....	....	1
Idaho	....	....	....	....	....	....	....	....	.....	1	1	.....	3,947	4,528	....	....	....	....	....	....	....	....	1	1	1	....	....	2
Illinois	128	....	....	164	2	294	224	315	677,133	1,705	2,466	— 30.9	3,859,260	5,771,181	....	....	....	74	74	9	....	1	493	503	652	258	255	279
Indiana	15	....	....	48	....	63	35	75	119,802	421	439	— 4.1	690,212	770,163	....	....	....	12	12	1	....	....	110	111	112	120	119	90
Kansas	169	....	26	166	6	367	378	361	1,292,902	2,768	3,106	— 10.9	9,844,456	10,853,754	10	....	1	81	92	75	....	19	578	672	834	563	581	509
Kentucky	66	....	11	111	3	191	176	198	264,443	1,111	1,241	— 10.5	1,649,601	1,816,405	....	....	....	11	11	12	....	....	68	80	110	139	126	124
Louisiana	151	19	18	136	....	324	314	303	2,279,060	2,428	2,439	— 0.5	19,381,803	18,110,825	4	4	2	47	57	21	27	10	333	391	420	427	422	403
North Louisiana	79	....	8	57	....	144	132	147	478,769	898	1,030	— 12.8	3,284,676	3,759,842	2	....	1	17	20	5	2	3	103	113	140	83	78	79
South Louisiana	72	19	10	79	....	180	182	156	1,800,291	1,530	1,409	+ 8.6	16,097,127	14,350,983	2	4	1	30	37	16	25	7	230	278	280	344	344	324
* Gulf of Mexico	14	....	4	16	....	34	55	34	323,805	437	295	+ 48.1	4,086,919	2,754,678	....	....	1	4	5	7	4	3	37	51	48	95	92	54
Maryland	....	....	....	....	....	....	....	....	.....	.....	4	—100.0	.....	30,716	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Michigan	14	....	12	15	....	41	28	33	121,818	261	304	— 14.2	750,846	864,876	1	....	1	9	11	8	....	1	85	94	109	75	74	69
Mississippi	10	3	....	28	....	41	31	38	327,673	250	286	— 12.6	1,801,992	2,061,261	2	....	....	21	23	9	1	....	125	135	124	49	42	37
Missouri	1	....	....	....	....	1	2	....	1,418	4	21	— 81.0	4,169	23,811	....	....	....	....	....	....	....	....	4	4	15	....	....	1
Montana	13	....	5	23	....	41	44	69	177,705	263	314	— 16.3	1,335,512	1,562,795	....	....	1	19	20	2	....	2	85	89	121	47	48	54
Nebraska	32	....	....	58	....	90	84	72	539,290	597	668	— 10.6	3,528,865	3,861,580	6	....	....	41	47	25	....	1	284	310	326	40	49	28
Nevada	....	....	....	1	....	1	....	....	4,850	4	5	— 20.0	10,568	28,571	....	....	....	1	1	....	....	....	4	4	3	2	3	3
New Mexico	90	....	32	36	1	159	191	196	778,685	1,466	1,343	+ 9.2	6,741,703	5,997,337	3	....	2	21	26	32	2	6	164	204	182	192	194	184
New York	21	....	1	2	24	48	48	55	69,900	327	296	+ 10.5	533,900	414,850	....	....	....	....	....	....	....	....	....	....	....	58	62	74
North Dakota	7	....	....	11	....	18	21	16	119,615	171	185	— 7.6	1,202,548	1,372,557	1	....	....	9	10	9	....	....	68	77	59	40	28	26
Ohio	46	....	12	21	....	79	106	117	172,486	654	697	— 6.2	1,562,399	1,675,780	....	....	....	1	1	....	....	....	6	6	3	208	224	221
Oklahoma	281	3	30	194	11	519	552	669	1,863,324	3,880	5,455	— 28.9	14,071,238	19,571,133	7	1	4	53	65	45	7	17	373	442	572	606	618	591
Oregon	....	....	....	....	....	....	1	....	.....	2	1	+100.0	10,392	12,880	....	....	....	....	....	....	....	....	2	2	1	1	1	....
Pennsylvania	36	....	21	5	34	96	91	100	217,733	635	563	+ 12.8	1,699,741	1,550,827	....	....	3	1	4	....	....	22	8	30	....	189	184	169
South Dakota	....	....	....	3	....	3	2	7	7,658	30	14	+114.3	113,525	57,721	....	....	....	3	3	....	....	....	28	28	14	1	1	3
Texas	1,049	52	101	598	8	1,808	1,986	2,149	7,871,379	14,805	15,436	— 4.1	62,173,798	65,312,296	37	8	6	353	404	257	45	47	3,059	3,408	3,729	1,267	1,304	1,274
Dist. 1: South Central	49	3	....	35	....	87	101	193	237,163	884	1,419	— 37.7	2,231,911	3,756,874	1	....	....	24	25	14	1	1	234	250	333	52	49	42
Dist. 2: Middle Gulf	20	11	17	30	....	78	84	73	481,477	525	560	— 6.3	3,270,912	3,463,949	1	2	1	16	20	4	11	10	154	179	186	28	39	47
Dist. 3: Upper Gulf	54	15	10	80	....	159	127	148	1,054,181	1,162	1,210	— 4.0	7,730,882	8,110,116	5	2	....	35	42	20	8	1	282	311	315	114	112	137
* Gulf of Mexico	....	....	....	1	....	1	1	2	8,213	7	7	.....	52,372	73,322	....	....	....	....	....	1	....	....	2	3	4	....	1	4
Dist. 4: Lower Gulf-S.W.	46	20	11	68	....	145	119	118	777,460	984	995	— 1.1	5,158,108	5,280,518	2	1	....	42	45	12	7	2	279	300	337	83	85	64
* Gulf of Mexico	....	....	2	2	....	4	2	1	44,921	16	8	+100.0	161,150	78,081	....	....	....	2	2	....	....	....	2	2	1	2	3	2
Dist. 5: East Central	....	....	....	12	....	12	18	20	57,782	108	169	— 36.1	483,861	557,415	....	....	....	8	8	1	1	1	72	75	90	18	20	10
Dist. 6: Northeast	59	....	6	27	....	92	95	76	488,186	733	599	+ 22.4	3,967,723	3,159,164	1	....	1	24	26	4	2	4	160	170	155	63	64	85
Dist. 7-B: North Central	114	....	5	101	....	220	276	277	715,436	1,827	2,122	— 13.9	6,182,697	7,513,899	9	....	1	72	82	62	....	7	596	665	824	103	106	118
Dist. 7-C: West Central	63	....	2	19	....	84	95	165	402,415	800	907	— 11.8	3,622,859	4,082,072	4	....	1	9	14	35	....	6	234	275	229	85	90	120
Dist. 8: West	353	....	6	68	4	431	447	489	2,108,432	3,399	2,945	+ 15.4	16,667,262	15,120,402	9	....	1	44	54	57	1	4	297	359	366	371	376	300
Dist. 9: North	219	1	3	135	4	362	469	446	1,017,416	3,391	3,545	— 4.4	8,954,467	10,506,836	5	1	....	66	72	47	1	5	724	777	771	227	231	262
Dist. 10: Panhandle	72	2	41	23	....	138	155	154	531,431	922	965	+ 2.8	3,903,116	3,761,051	....	2	1	13	16	6	13	6	62	87	93	123	132	89
Utah	10	....	....	10	....	20	20	13	107,079	132	97	+ 36.1	753,285	453,679	....	....	....	7	7	7	....	2	51	60	65	75	58	28
Washington	1	....	....	....	....	1	1	....	4,130	4	1	+300.0	20,459	7,493	....	....	....	....	....	....	....	....	3	3	1	1	1	....
West Virginia	18	....	50	9	....	77	58	68	204,712	419	467	— 10.3	1,128,662	1,234,741	....	....	....	2	2	....	....	6	8	14	....	170	170	190
Wyoming	39	....	4	53	....	96	93	75	490,326	533	590	— 9.7	2,341,520	2,717,826	3	....	....	31	34	13	....	4	155	172	154	91	101	131
Total United States	2,427	77	337	1,823	89	4,753	4,845	5,338	19,224,601	35,674	39,413	— 9.5	147,070,340	159,888,169	82	13	21	877	993	554	83	150	6,771	7.558	8.357	4,945	4,983	4,819
Total Western Canada	203	....	26	86	4	319	286	429	1,483,942	2,061	1,934	+ 6.6	9,619,501	9,159,918	....	....	....	....	....	....	....	....	....	.....	.....	231	220	252

* Gulf of Mexico wells are included in their respective District totals.

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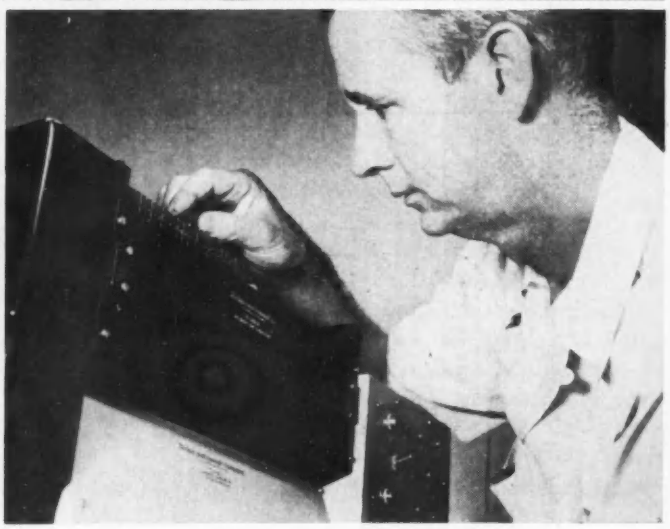

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Location of Ground Recording Sites

One aspect of the IAGS program is its intimate interconnection with the Space Satellite program. Precise location of stations (indicated by black dots) to meter signals from the satellites has been established largely by IAGS geodetic work. Data developed by the two programs will be complementary.

Geodetic Survey to Spur Latin American Oil Growth

A vast military mapping program will provide the basic data useful to many industries—including oil and gas.

••••••••••••

CONSIDERABLE PROGRESS has been made during the past ten years toward mapping all of Latin America to modern standards of accuracy. Vigorous efforts have been made to establish first order ground control and triangulation nets extending over vast, remote areas in preparation for aerial photography. Later through use of stereo-pair photos and modern methods of interpretation and compilation, the final topographic maps are published and distributed to each participating government. The presence of accurate, monumented and documented ground control points in relatively undeveloped nations will be of great help to oil explorers. The ability of Latin American governments to make accurate topographic maps available to reputable industrial concerns with development rights in these countries will make it unnecessary for such firms to do much expensive preliminary basic exploratory work.

Postwar Program. World War II emphasized the inadequacy of our worldwide map coverage from the military viewpoint. However, great strides were made during hostilities in mapping large areas quickly and accurately by aerial photographic methods. At the end of the war, Pres-

ident Truman sent letters to the secretaries of War, Navy and State suggesting that a comprehensive mapping program be started in friendly foreign areas and thus initiated a world-wide cartographic program, guided and assisted by the U. S. In 1946, the Inter American Geodetic Survey was established and now coordinates the geodetic work in which many groups are participating.

In addition to the U. S. Army, Navy and Air Force, the U. S. Coast and Geodetic Survey, U. S. Geological Survey, other agencies, and 17 nations are formally assisting this program to map the entire area of Latin America. Argentina, Paraguay and Uruguay are not participating formally, but liaison with these countries is carried on through the Pan American Institute of Geography and History (affiliated with the Pan American Union). The Institute recognizes the same standards of map accuracy formulated by the Army May Service, IAGS officials hope that Argentina, Paraguay, and Uruguay will enter into the program formally, but satisfactory map coverage of these nations is not necessarily dependent on their formal participation because there are efforts underway to effect full coverage through coordination of the IAGS program with similar work coordinated by the Pan American Institute.

Accords have also been reached with the British, Dutch and French governments so that their territorial possessions in Latin America may also be covered by the IAGS program.

Headquarters of the IAGS are located at Fort Clayton, in the Canal Zone. A military organization, IAGS has more civilian than military personnel. In March 1955, its personnel numbered 25 officers of the Corps of Engineers, 17 warrant officers, 42 enlisted men and 280 civilians. Col. F. J. Tate, C. E., is the current director. A U. S. Coast and Geodetic Survey officer serves IAGS as technical consultant. Assigned to the IAGS also is the 937th Engineer Aviation Company, including 158 officers and enlisted men, equipped with 24 light conventional aircraft and 20 helicopters. Another unit, the 551st Engineer Base Survey Company, with 134 personnel, was assigned to the IAGS two years ago.

The over-all program, including organizations of participating nations, involves an annual expenditure of 12 to 14 million dollars, employs over 5,000 people and utilizes about $50 million worth of plant and equipment. The U. S. contributes $2 million to $3 million annually and the collaborating Latin American nations jointly carry the rest of the budget.

Field Organization. The IAGS field organization spreads over 12 million square miles, an area measuring over 6000 miles between its southern and northern extremes. Minimum objectives require establishment of 90,000 miles of primary triangulation arcs and 195,000 miles of primary level lines; painstaking measurement of 250 base lines; establishment of 350 astronomic stations, of particular use in remote Amazon and other jungle areas; installing and observing 200 tide gages; and use of 3000 geophysical stations where gravimetric variations and magnetic declinations are being determined. This preliminary work is beyond the midway stage.

Inherent in such work are great hardships. IAGS personnel, some of whom paraphrase the abbreviation of the agency's name to read "I'm always going somewhere," have to endure the hazards of hot, unhealthy rain forests and jungles in the Amazon, bitter cold, wind, and lack of oxygen atop 17,000-foot peaks in the Andes and glaciers and landslides in southern Chile. IAGS engineers have routinely climbed high peaks, read their instruments, and have emplaced their ubiquitous bronze discs in concrete and bedrock, reading "Servicio Geodético Interamericano" followed by basic geodetic control information.

These discs are very similar in appearance to those so familiar in the U. S., emplaced for the same purpose by the Coast and Geodetic Survey. Mountain climbers in Latin America have allegedly been embarrassed by finding these discs, landmark of IAGS "Kilroys." Attempts to make a publicity splash by climbing a mountain for the "first" time have backfired when it was discovered later that some work-a-day IAGS engineer monumented geodetic ground atop a mountain several years before and didn't bother to tell anyone about it in nearby towns.

IAGS personnel have found oil seeps in northeastern Peru in virtually impassable swamp and jungle country. They are crossing paths with oil hunters, as occurred in the Maranon region of the Peruvian Oriente in 1955. A cartographic party came upon Texas Petroleum Company's rig then engaged in drilling Maranon 8.1 (World Oil, Feb. 1, 1956, p. 165), when neither the mappers nor the oil men were aware of each other's work. TexPet employes were quoted as saying they would welcome acquisition of better maps of the area than they had at the time.

One of the finest aspects of the IAGS program is that many Latin Americans have become highly competent in technical and scientific endeavors related to cartographic work. The IAGS has a school in the Canal Zone. During the years 1952-55, more than two hundred students from the 17 participating Latin American countries learned such subjects as surveying, photogrammetry, astronomy, map reproduction, and drafting.

Each Latin American nation has an agency through which the IAGS coordinates common standards of map accuracy and standard operating procedures. In Chile and in Peru the agencies are called Instituto Geographico Militar. In Guatemala, the Direccion General de Carografia carries on the program there. As each agency becomes more competent to carry out all phases of the project, there is a corresponding withdrawal of U. S. technical assistance as it becomes unnecessary. The Latin Americans have taken great and justifiable pride in the program. In fact, something of a rivalry seems to be developing between the nations regarding rate of progress. Nicolas Arroyo, Minister of Public Works of Cuba, stated on Jan. 29, 1957, that Cuba would be the first country in the Western Hemisphere to have complete topographic mapping from aerial photography and photogrammetry. But the small country of El Salvador in Central America may have full coverage under the IAGS program by the middle of 1957, so Cuba will have to hurry to be the first. The Cuban government has hired Aero Service Corporation of Philadelphia to afford the nation with complete aerial photographic coverage, coordinated with the Cuban Instituto de Cartografia and the IAGS.

Other aerial photographic firms

working under contract of the IAGS include Hycon Aerial Surveys of Pasadena, Calif. Hycon has photographed large areas in Peru, Chile, Colombia, Bolivia and Ecuador from a P-38 flying at 36,000 feet. Fairchild is also doing IAGS work.

A little known aspect of the IAGS program is that it is tied in closely with the Earth Satellite program. Ground recording sites for receipt of signals for the first satellite, expected to be launched during the International Geophysical Year of 1957, include stations in Cuba, Panama, Ecuador, Peru and two in Chile. Data on the shape and curvature of the earth is expected to be interpreted from signals received from space satellites if they are successful. New data from satellites should serve as a check on previous geodetic work by the IAGS, and vice versa.

IAGS maps have the same standards of accuracy, but may be adapted to the more specific needs of the different participating governments. The scale of the base maps is 1:250,000. A vast country like Brazil would naturally tend to find large scales most useful. But a small one, like El Salvador, wants a smaller scale. Maps of El Salvador on a 1:50,000 scale are almost completed, and officials there are discussing another go-around of mapping on a 1:25,000 scale and even a third on 1:10,000 or 1:5,000. Colombia, apparently with oil prospecting in mind, has pushed completion of maps in the lower Magdalena River valley area in preference of some other areas within its borders.

The Army Map Service in Washington, D. C., uses its facilities to complete and publish these maps from IAGS field data. Then it makes available to the government concerned as many copies as are requested. The Army maintains some copies of the maps produced for its files. In keeping with its agreement, the U. S. Army cannot furnish copies of these maps to anyone without the consent of the government concerned, so that requests for IAGS maps should be directed to the individual Latin American governments.

The IAGS program will facilitate many endeavors of progress. Development of all mineral resources will be enhanced. Roads, water mains, irrigation systems, and power lines will all be constructed more quickly and at less cost than would be the case in the absence of the program. Greater knowledge of our Hemisphere, and further scientific education and experience has been gained by nationals of many countries. Good will and understanding have been furthered. The job of mapping never ends, because the very construction and development projects that mapping furthers, immediately make the maps upon which they are based obsolete. So IAGS officials are reluctant to say when the program will end, though they are hopeful that cartographic techniques will continue to improve by leaps and bounds and make their job easier and quicker.

The economic development inevitably following the basic map work will make it easier for Latin American nations to diversify their economies. Venezuelan oil, Cuban sugar, Brazilian coffee, Bolivian tin and Chilean nitrates should no longer be in a position to make or break the respective economies due to the ups and downs of the international markets for these commodities. Democratic governments should have greater stability in the future in Latin America than in the past as a result.

Oil men have already reaped tangible benefits from IAGS ground control and maps in Latin America. Bolivian Gulf Oil Company is using AGS ground control in an aerial photographic survey. Asked to comment on IAGS assistance in Guatemala, where Aero Service Corporation is conducting an airborne magnetometer survey for oil in the isolated Peten Province, Aero officials said this: "We have been aided very materially by the Direccion General de Cartografia and by the IAGC. A network of first order stations exists in Guatemala, and some areas of the network are situated near the mountain tops where we wish to establish Shoran stations. Shoran, being a line of sight operation *(similar to Radar in principle)* works best from a high point. Cartografia and the IAGS are triangulating these mountain-top positions, and helping us to occupy them. Their helicopters are helping us to get to difficult places, and in other areas their line cutters are helping us to clear paths to station areas.

"In general, these agencies are counseling and advising us from their intimate knowledge of the difficult local terrain, and this sort of cooperation very materially advances the progress of the survey." The magnetometer survey is being done jointly for 13 oil companies. In return, the companies will make available to the Guatemalan government without cost Shoran data from the survey. Shoran techniques are capable of establishing second order geodetic control.

Gravity and magnetic work has been done by the IAGS, so far strictly for geodetic purposes. However, there has been considerable interest in a study of gravity anomalies from Rio de Janeiro in Brazil, northward to the interior part of the country west of Recife. It is possible that this study might facilitate oil exploration there. Of course, all oil exploration techniques will be facilitated by the mapping; surface geology, gravity, magnetic, and seismograph. Pipe line and road construction can be better planned and carried out. Most of the benefits are obvious.

But a very important bright spot that may not be so apparent is that the IAGS work should help settle boundary disputes, both current and potential. At least one company applying for a concession in the extreme northeastern portion of the Peruvian Oriente was warned by Ecuador that the area was considered to lie within its own borders and a Peruvian concession would thus be disputed by Ecuador. Oil seeps are reported in that area, so it is a bone of contention, although most of it is virtually impenetrable jungle now.

Thus, it is of great importance that accurate geodetic work is being done before the majority of the areas covered becomes of enough value to be worth an ownership dispute. Guatemala takes a dim view of British claims in Belize, though there is a common border, vaguely defined, 130 miles long. At one time, Honduras and Nicaragua seemed willing to let IAGS determine the exact location of an ill-defined portion of the border between the two nations. So there is clearly a bright potential, thanks to the IAGS, for oil men entering Latin America to be relatively unfettered by future border disputes which otherwise might make whatever production found the proverbial bone between the two proverbial dogs.

—The End

Pre-Pennsylvanian Possibilities

Activity Is Picking Up in Eastern Kansas

Shallow drilling and high discovery rate are attracting both independents and majors. Operators seek oil and gas in rocks of Mississippian and older ages.

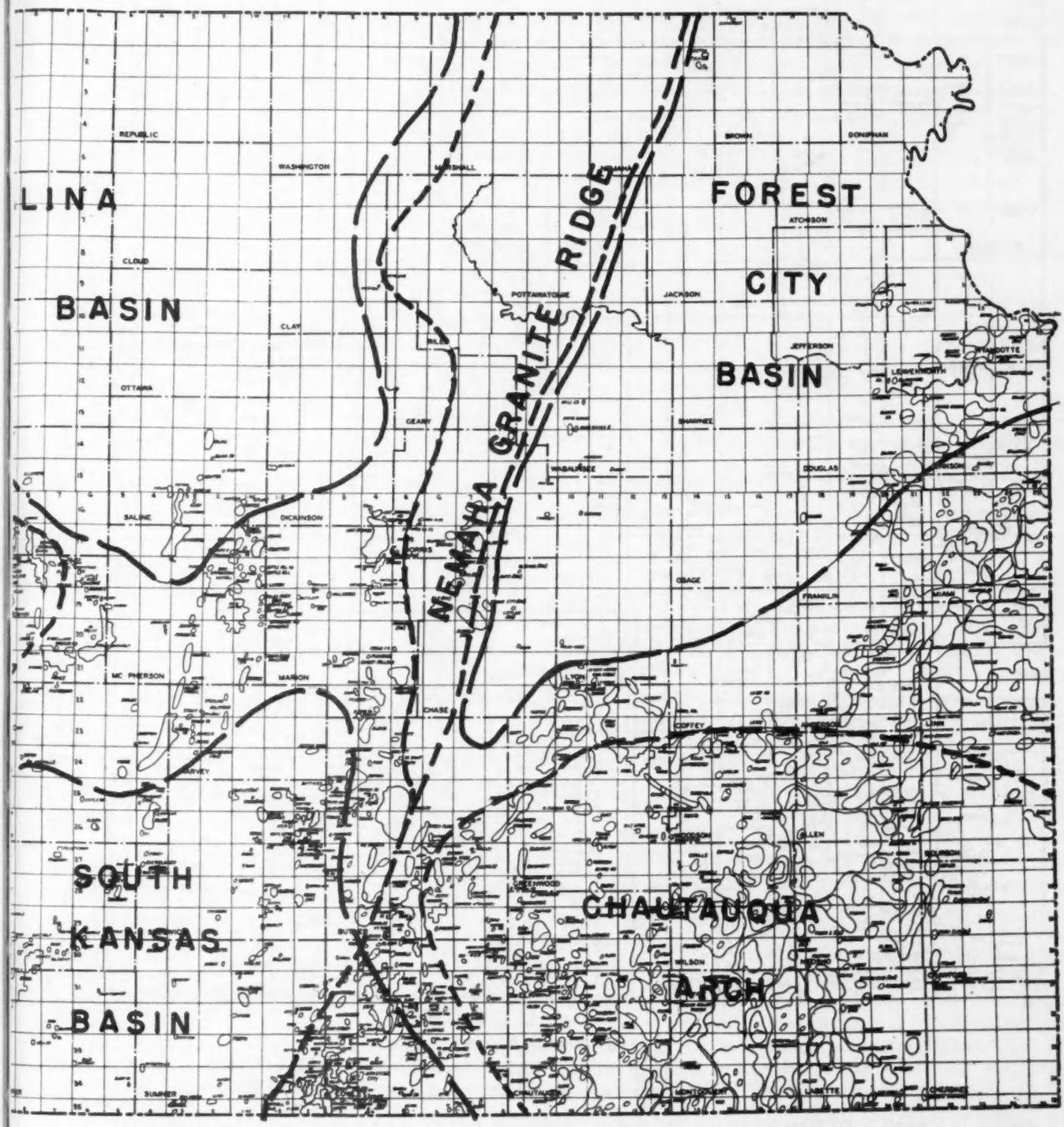


FIGURE 1—Kansas geological subdivisions.

By F. W. MORGAN and M. E. TORLINE
Wichita, Kansas

FOR ABOUT two years, an older area in Kansas has been receiving renewed attention from both independent operators and major companies. New oil reserves are sought through a different approach in method of exploration. This area is the western flank of the Chautauqua Arch of Eastern Kansas (Figure 1). Specifically the intent here is to outline activity and results, old and new, in the counties shown in Figure 2. Here are shown the new pools which are the results of this exploratory activity and the older pools whose presence and type of production has sparked the new play.

The purpose of this recent exploration has been to find oil and gas in rocks of Mississippian and older ages. Heretofore, in recent years numerous sand plays have been made in order to find and exploit Pennsylvanian sands. Their success is attested by the number of primary and secondary recovery projects now operating in the area.

Geology. Surface rocks dip gently to the west in Kansas, the older formations being exposed progressively deeper to the eastward. Mississippian

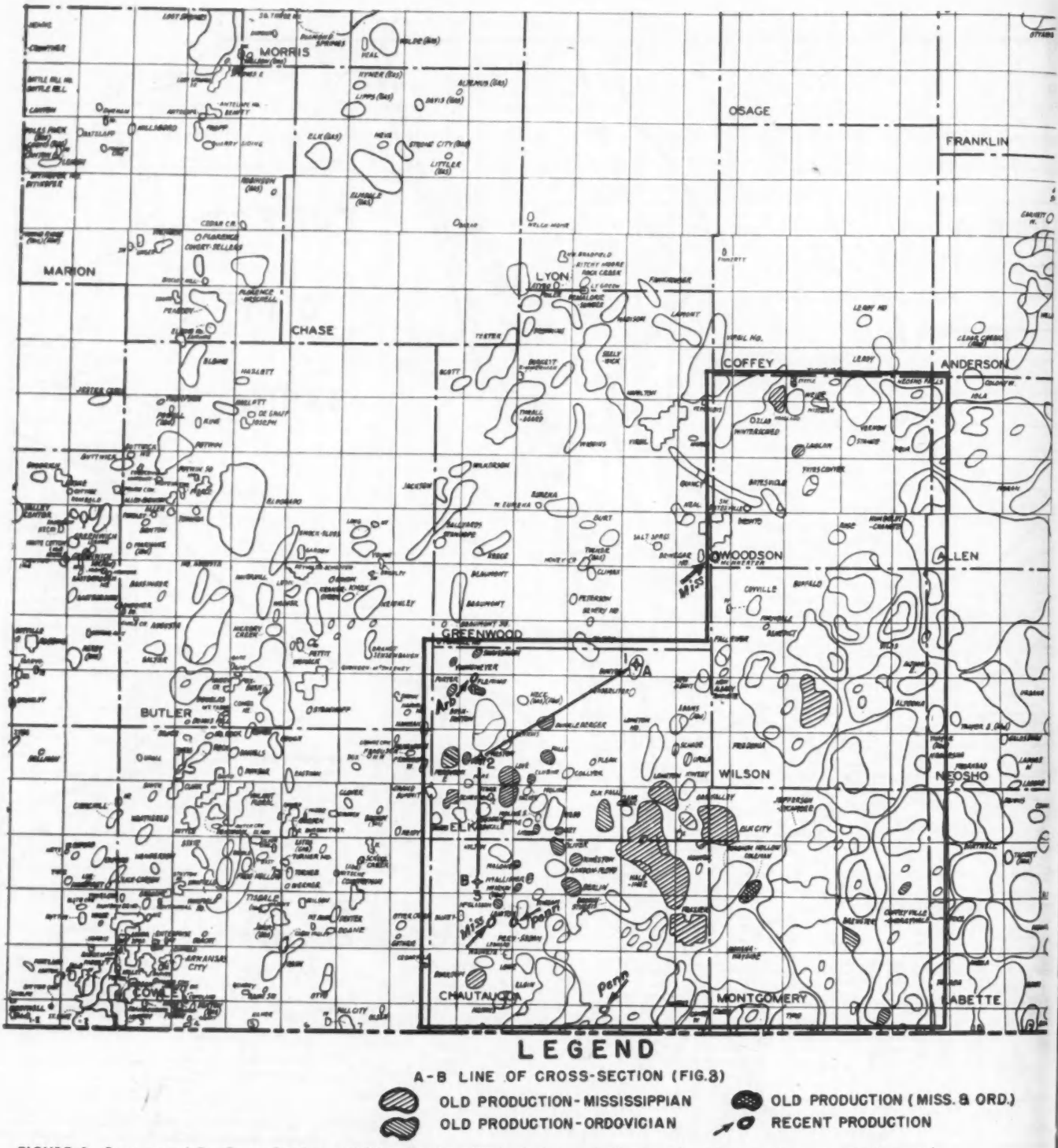
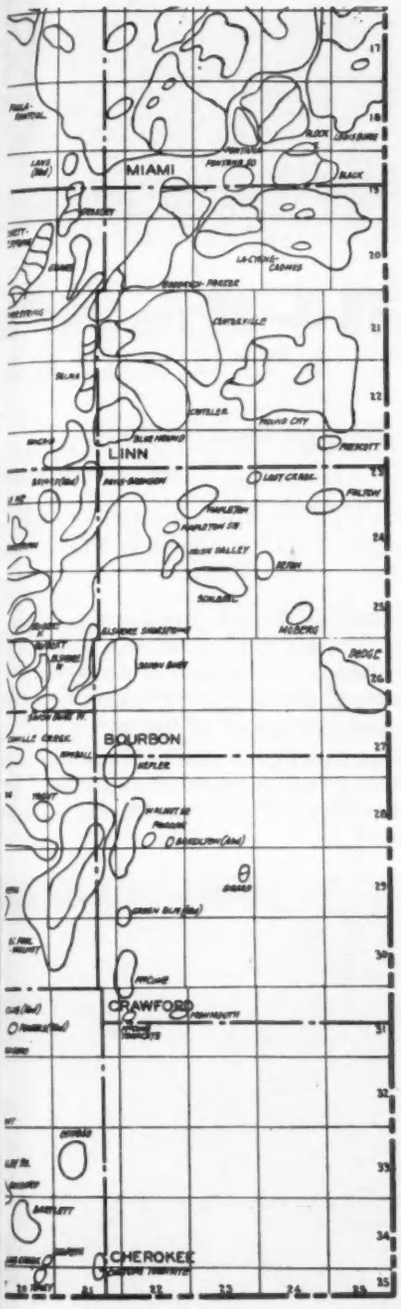


FIGURE 2—Summary of Pre-Pennsylvanian activities showing old producing and abandoned pools as well as recent discoveries.

rocks are exposed at the extreme southeast corner of the state, and Permian sediments can be seen in Cowley and Butler counties to the west. Subsurface formations generally parallel surface structure and dip in the state, giving rise to the term "pancake geology." For Kansas is an area where most of the rocks consist of fairly thin interbedded shales, limes, and sandstones. However, in the Pre-Pennsylvanian sediments much more massive and thicker limestones are found, and there is less sand and shale in the section. In the cross-section (Figure 3), Lower Pennsylvanian subdivisions contrast vividly with the massive limes of the Mississippian and Pre-Mississippian sediments.

Mississippian rocks in this part of the state may be lower Meramac or upper Osage at the top. If the Warsaw limestone is present it is usually as an outlier of somewhat limited areal extent. Widespread basin deposits known as the "Cowley formation" are commonly found at or near the top of the Mississippian in this area. These rocks consist of dark, silty dolomites and dark, opaque cherts. They may represent all or any part (Well 2, Figure 3) of the Mississippian limestone facies, and, when present, usually mean the presence of a basin eroded in Osage and older rocks that is filled with this material. In this event, there are no Mississippian reservoirs left for oil accumulation.



If no Cowley is found there are two types of reservoirs that may be present in the Mississippian. First, there may be a weathered, conglomeritic zone at the top consisting of weathered, porous chert. Commonly it is a white, cottony chert with fine, vugular porosity. This type of chert is called "chat" and is responsible for the production of oil in many places in Kansas. It is, however, extremely variable in its thickness, porosity, and permeability. In many wells it consists of chert nodules imbedded in shale. Though there may be shows of oil present under such conditions, the impermeable nature of the shale prohibits any production. Second, below the "chat" porous zones may be developed in the Keokuk limestone of Upper Osage age. These zones represent a development of a tan or brown, sucrose, cherty, porous, limey dolomite which carries shows of oil on anticlinal structures. Again, this reservoir is extremely variable as to thickness, porosity, and permeability development. In many wells it is entirely absent but seems to be present more often on structure than off. The leached, weathered, porous character of the tan, fossiliferous chert always associated with the zones indicates that this, too, may be a secondary development of porosity and accumulation. Below this zone, which may be 50 to 75 feet below the top of the Mississippian, there are no more shows of oil found.

Massive limes and dolomites are the rule in Mississippian rocks through the Osage and top of the Kinderhook. In the Kinderhook there is considerable variation in lithology above the Chattanooga shale which is the basal member. Usually on drilling wells the term *Kinderhook,* as called by geologists, is understood to mean the first shale in the series and may or may not be Chattanooga. In this area the Chattanooga consists of a dark gray to black, soft, spore-bearing shale that is generally blacker and softer toward the base. It commonly carries an odor of petroleum near the base. There is a good possibility that this shale is Pre-Mississippian in age, especially the lower part, but we have placed it in the lower Mississippian, as do most geologists in Kansas, for convenience sake (Figure 3).

On the Chautauqua Arch and immediately adjacent to it on the west all the Silure-Devonian and Upper Ordovician sediments have been removed. For this reason we find below the Chattanooga and separated from it by an unconformity rocks of Lower Ordovician age. These consist of the massive dolomites of the Arbuckle formation. At the top is found the Upper Arbuckle or Cotter-Jefferson City sequence undifferentiated. Generally these rocks are composed of white to tan, fine to medium crystalline dolomite with well-developed vugular and intercrystalline porosity. Cherts are common and may be white, opaque to milky, or white with large, brown oolites. The porosity will, on structure, carry shows of oil and gas. This part of the Arbuckle has, over the state of Kansas, produced more oil than any other reservoir. It has produced large quantities in this area and will continue to do so.

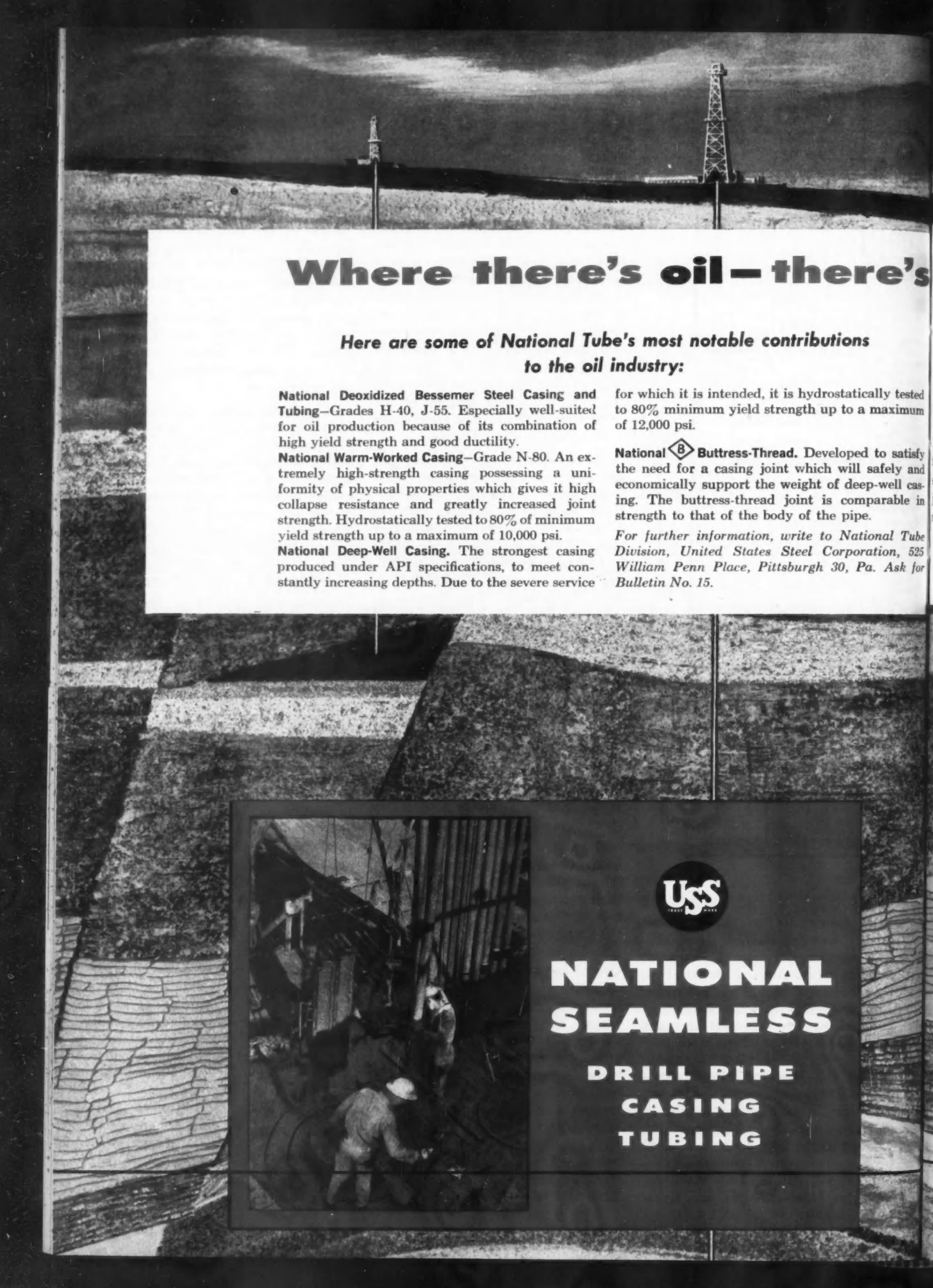
From the foregoing description of Mississippian lithology, it is readily understandable that proper stratigraphic conditions are fully as important as structure. However, when good reservoirs are located, a certain amount of structure is necessary in order to trap commercial quantities of oil. Fortunately, it seems structural development and stratigraphic development go hand in hand. Furthermore, there is some evidence that porosity is similarly related to structural position.

"Chat" production is rather erratic, and it is obvious that a certain amount of clean, porous chert must be present. Shows of oil are common in the low wells as often as in the high ones. This probably is a result of a lack of permeability and consequently, of lack of migration of oil up-dip. However, there seems to be some correlation between structure and production from this zone. Probably additional leaching and absence of shale on topographic high areas are most important factors in explaining this condition.

The Arbuckle usually has well-developed porosity. It also has a very effective water drive so that the wells will generally increase in water percentage to economic limits of production. This may be at varying rates in different pools and in individual wells in a pool. It appears that the amount of closure on the pool, and therefore the thickness of the oil column is the most important factor in determining this decline of oil and increase in water production. Ordovician structures will generally underlie Mississippian structures. That is to say some indication of Ordovician structure can be recognized in the Mississippian even though it may be apparent only by a recognizable thinning.

History of Pre-Pennsylvanian Exploration. Although oil was first found in Kansas in 1860 near Paola (Miami County) it was not until the 1920's that serious consideration was given to drilling Mississippian and older rocks in this area. There were two reasons for this. First, the difficulty of drilling below the top of the Mississippian with the cable tool rigs then in use was very discouraging and

Figure 3 on Page 136, text continued on Page 138 ➔



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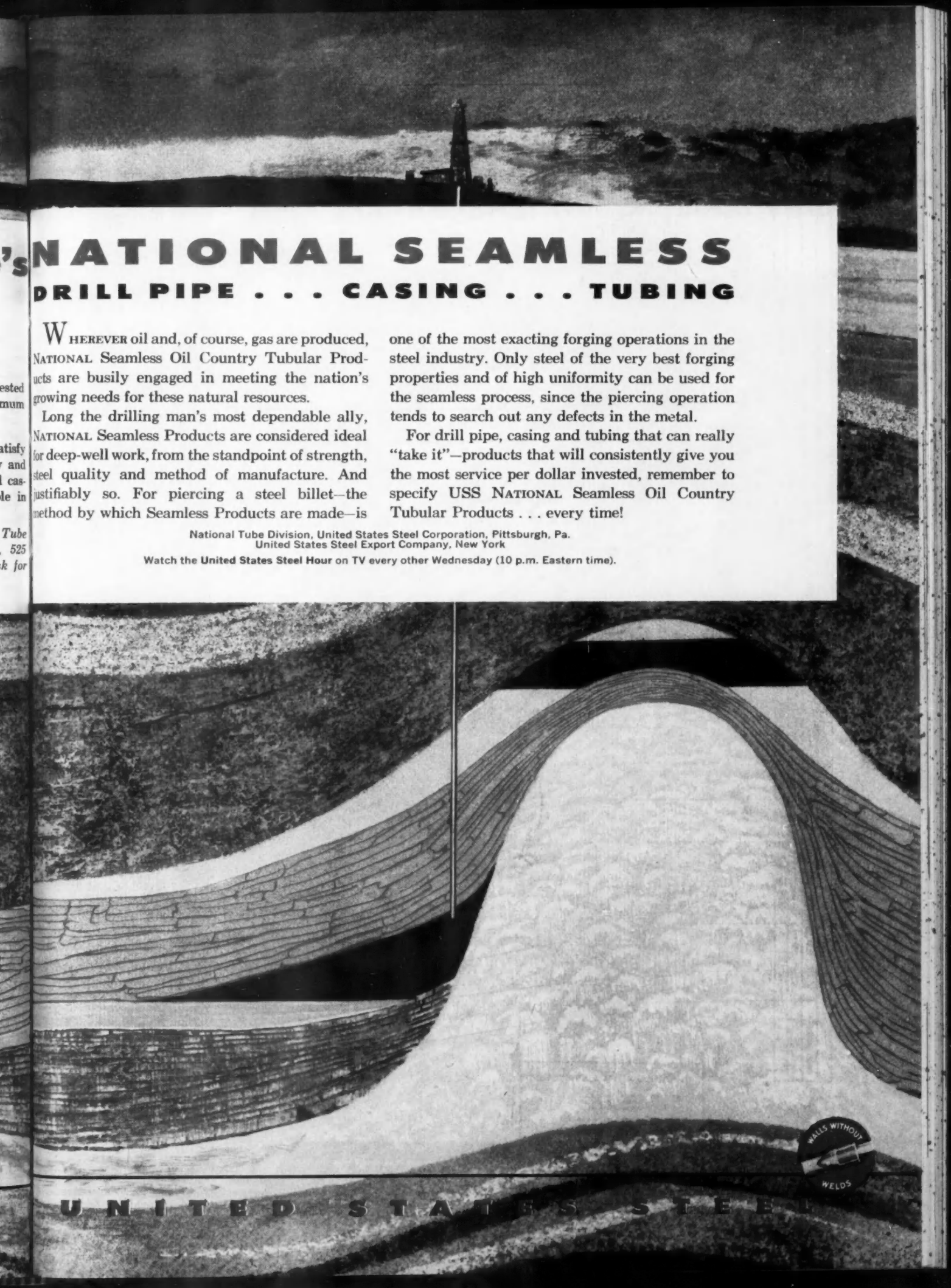

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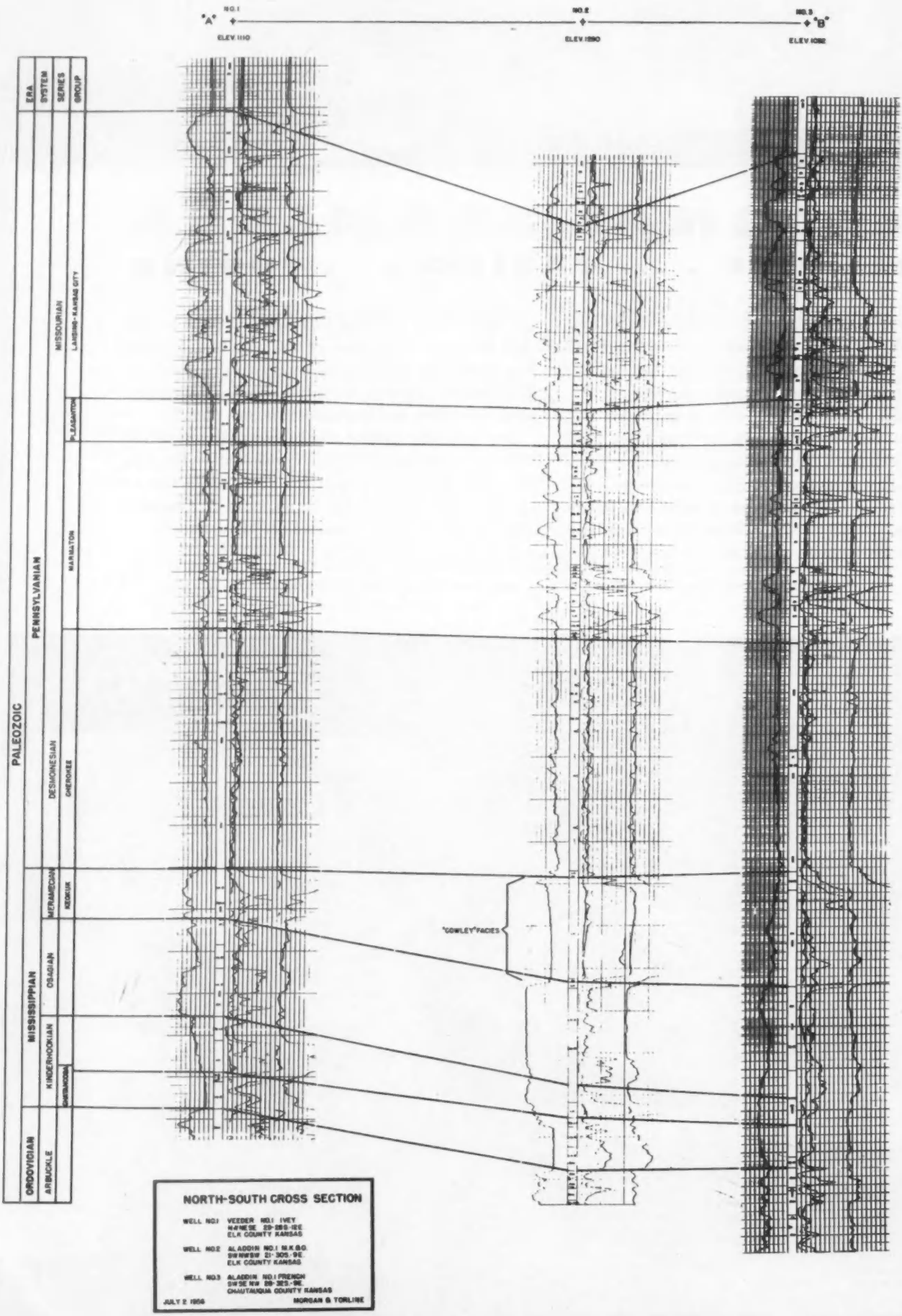

FIGURE 3—North-South cross-section along western flank of Chautauqua Arch in Eastern Kansas.

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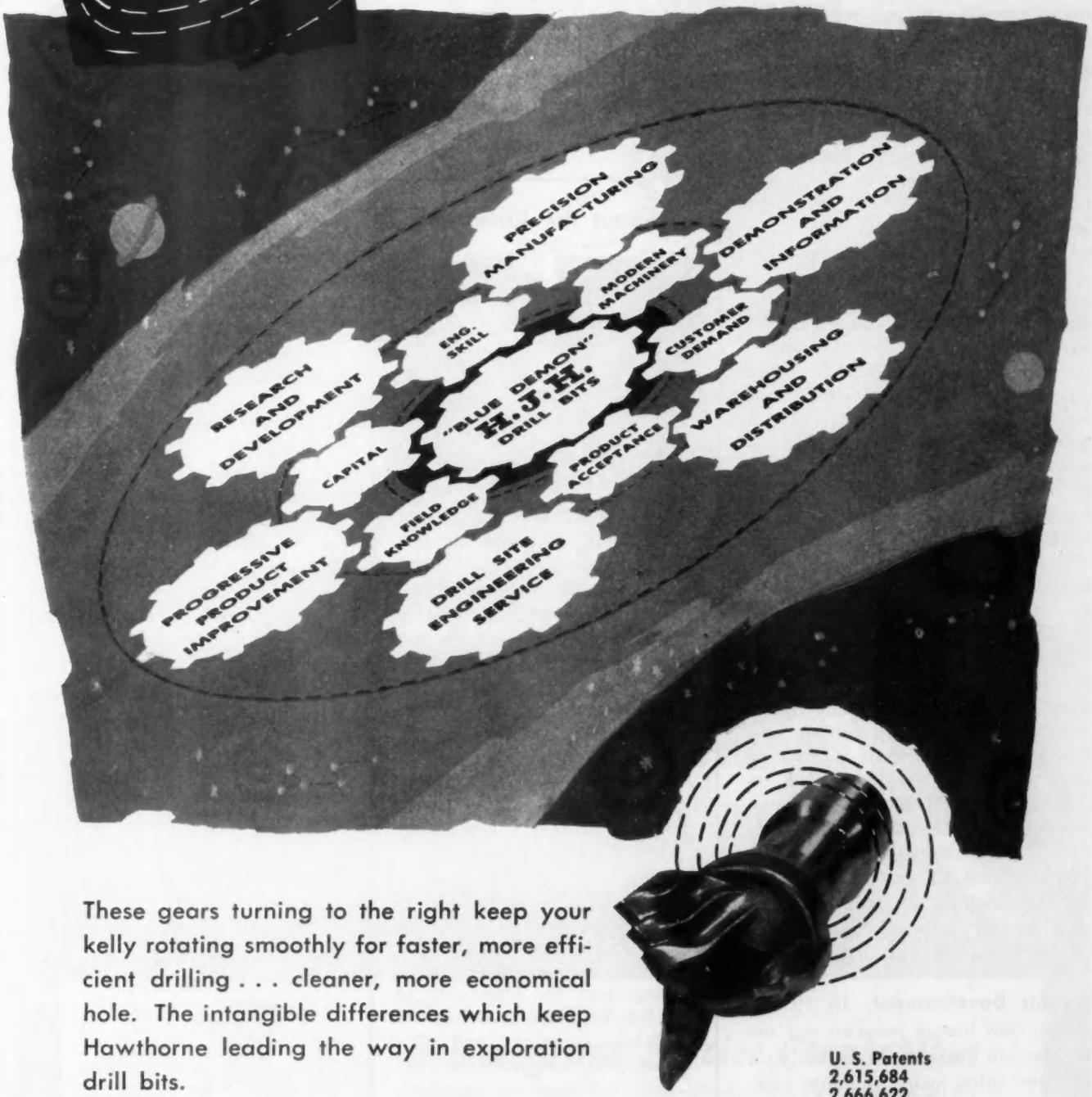

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is still a slow process even with modern rotary equipment. Second, the discoveries of the prolific Mississippian and Ordovician pools on the Nemaha Anticline (Figure 1) to the West sparked exploration programs all over the mid-continent area in search of similar pools in the same reservoirs. It is not known for sure who found the first Pre-Pennsylvanian oil in this area, nor when it was found. However, at least two Arbuckle pools were drilled in 1921 in Montgomery County. As late as 1950, production was revived in the Ferguson Pool in Elk County in Ordovician rocks. Recoveries cannot be given with any degree of accuracy because of multiple pays on leases in some pools where no separate records were kept for each. Other recovery figures are so inaccurate as to be meaningless. However, we do know that wells have been completed for initial daily productivity rates from 25 barrels to 100 barrels. The average Arbuckle well is probably about 100 to 200 barrels per day. Mississippian averages somewhat smaller. In the past, Mississippian has been known as a producer of small wells with a long life, and Arbuckle as flashy with a rapid decline and excessive water. This applies, of course, to the older pools in the area. It is felt that with the newer completion and production techniques, better and more stable production can be obtained.

Figure 2 summarizes Pre-Pennsylvanian information by showing old pools producing or abandoned in these reservoirs and by showing new discoveries. Nevertheless, it must be understood that adequate and reliable information, both old and new, is scarce. Only recently have the Kansas Oil Scouts started reporting these wells, and not all are reported as yet. All available data has been plotted so that we have a good, representative picture of what is happening.

Recent Development. In 1955 a tremendous leasing program was undertaken in this area for the first time in some thirty years by major companies, with most of those operating in Kansas participating. The play really started in the Osage of Oklahoma, which is to the south. Drilling activity and discoveries there brought about a move to the north by companies and independents. An exploration program was immediately undertaken to evaluate these blocks and scattered leases. Drilling deals, support money, farm-outs, and other methods of financing drilling campaigns became relatively easy to obtain. The primary method of exploring the area has been wildcatting, based partly on subsurface geology (new to this area) and partly on economics. Such exploratory drilling is relatively cheap because the pays are shallow, the Arbuckle being only some 2600 to 2700 feet deep at its lowest place, in southwestern Chautauqua County.

About the Authors

F. W. MORGAN is a partner in the geological consulting firm of Morgan and Torline, Wichita, Kansas. Prior to this affiliation he had worked for Stanolind Oil and Gas Company and The Lario Oil and Gas Company until 1951 when he entered into partnership with M. E. Torline. His experience includes geological work in Kansas, Texas, Oklahoma, Nebraska and Colorado. He is a graduate of The University of Texas.

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EUGENE TORLINE is a partner in the geological consulting firm of Morgan and Torline, Wichita, Kansas. After graduating from the University of Wichita he joined Stanolind Oil and Gas Company and continued with that firm until 1951 when he became an independent geologist and lease broker. The same year he entered into his present partnership with F. W. Morgan. His geological experience includes work in Kansas, Oklahoma and Colorado.

Numerous wildcat completions have been counted in these counties since the lease play began in 1955. It is certain that some have not been reported, mainly in Montgomery and Wilson counties where none have been counted and some have probably been drilled, since the lease play pretty well covered these two counties. Woodson County accounts for several wildcats. Elk and Chautauqua counties have had considerable wildcatting. Of these exploratory wells, relatively high proportions have found oil and gas production (Figure 2).

There has been, of course, a certain amount of development following the opening of these new pools. These wells have not been included in the summary of activity. In addition, there has been a lot of drilling around older pools where Pre-Pennsylvanian production has been found earlier or where operators suspected it might be found. It is known, however, that considerable success has been obtained in these activities.

Future Prospects. As long as major companies hold leases here which they want to evaluate, activity should remain high. The shallow depths and comparatively low cost of drilling and completing wells makes it attractive to individuals who have rather limited capital. Furthermore, the high rate of discoveries will act as an added incentive to stimulate drilling of both exploratory and development wells. It is too early, and the results are too incomplete to estimate the reserves thus discovered. There is no doubt that additional pools will be found and that development will continue to add reserves to older pools. Some of the oil found will be Pre-Pennsylvanian and some will be Pennsylvanian.

This western flank of the Chautauqua Arch should add its part to the over-all picture of the oil industry in Kansas for a long time to come.

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Skelly Has Big Gasser at Its Mississippi Wildcat

Skelly Oil Co. has completed a high-flowing dual zone gas discovery at a Mississippi wildcat in which there has been considerable Tulsa interest. Kin-Ark Oil Co. is a partner in the well.

The operation is the No. 1 Dexter, located in Walthall County, Miss., about 90 miles south of Jackson. It is an area in which Skelly owns a block of 6,200 acres, in Walthall and Marion Counties.

From Lower Tuscaloosa sand at approximately 9,500 feet, the well had a potential open flow of 38 million cubic feet per day, with about 20 barrels of distillate per million. From the Paluxy sand at 13,500 feet the potential flow is 2,600,000 cubic feet per day.

The well was drilled to a total depth of 13,868 feet. Although definite plans have not been announced, future development of the area is expected.

Reprinted from the TULSA TRIBUNE July 9, 1957

CONGRATULATIONS . . .

to the Skelly Oil Company on its discovery of the new Dexter oil and gas distillate pool in south-central Mississippi.

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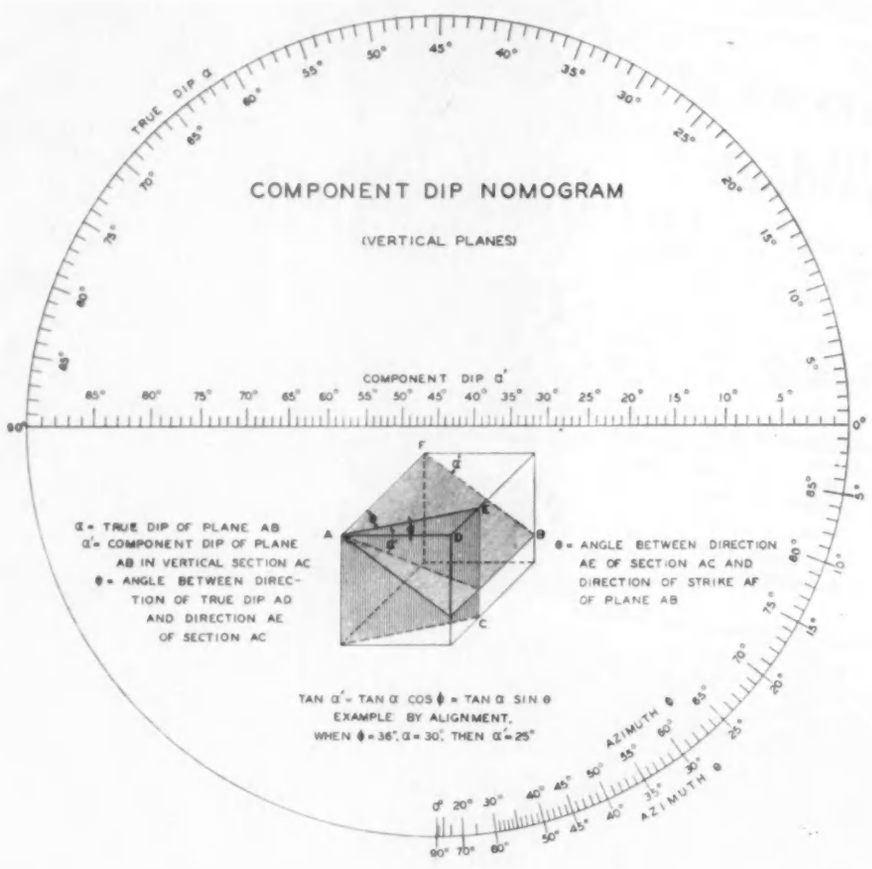
COMPONENT DIP NOMOGRAM
(VERTICAL PLANES)
TRUE DIP α
COMPONENT DIP α'
α = TRUE DIP OF PLANE AB
α' = COMPONENT DIP OF PLANE AB IN VERTICAL SECTION AC
φ = ANGLE BETWEEN DIRECTION OF TRUE DIP AD AND DIRECTION AE OF SECTION AC
θ = ANGLE BETWEEN DIRECTION AE OF SECTION AC AND DIRECTION OF STRIKE AF OF PLANE AB
TAN α' = TAN α COS φ = TAN α SIN θ
EXAMPLE BY ALIGNMENT,
WHEN φ = 36°, α = 30°, THEN α' = 25°
AZIMUTH φ
AZIMUTH θ

Component Dip Nomogram

The determination of the magnitude and direction of component dip from the magnitude and direction of the true dip can be obtained by use of circular nomograms.

By John Bemrose
Sohio Petroleum Company
Oklahoma City

WHEN THE MAGNITUDE and direction of a true dip of a plane are given the magnitude of the component dip in a vertical plane in any direction may be very conveniently solved for routine work by means of a circular nomogram.

Let (α) be the true dip and (α') the component of the true dip in a direction which makes an angle (ϕ) with the direction of the true dip, then it is well known that:

$$\text{Tan } \alpha' = \text{Tan } \alpha \cos \phi \qquad 1.$$

or,

$$\text{Tan } \alpha \cos \phi - \text{Tan } \alpha' = O \qquad 2.$$

so that, if (m) is a scale factor, the constructional determinant for the nomogram may be written:

$$\begin{vmatrix} \frac{m}{1+\text{Tan}^2 \alpha} & \frac{m \text{ Tan } \alpha}{1+\text{Tan } \alpha} & 1 \\ \frac{m}{1+\cos^2 \phi} & -\frac{m \cos \phi}{1+\cos^2 \phi} & 1 \\ \frac{1}{1+\text{Tan } \alpha'} & O & 1 \end{vmatrix} = O \qquad 3.$$

Let:

$$x = \frac{m}{1+\text{Tan}^2 \alpha} \qquad 4.$$

and

$$y = \frac{m \text{ Tan } \alpha}{1+\text{Tan}^2 \alpha} \qquad 5.$$

then, eliminating (Tan α) between these two equations, it is found that:

$$x^2 + y^2 - m x = O \qquad 6.$$

which is the equation to a circle passing through the origin whose radius is equal to (m). Thus, the scale for the true dip (α) is therefore the upper half of the circumference of a circle of radius (m); similarly, the scale for the direction (ϕ) is the lower half of the circumference of the same circle, and the scale for the component dip (α') is the diameter of this circle separating the (α) and (ϕ) scales.

The completed nomogram is shown in Figure 1, together with an example from which it is seen that by a straight line alignment of the scales that when $(\phi) = 36$ degrees and $(\alpha) = 30$ degrees, the component dip $(\alpha') = 25$ degrees.

REFERENCE

Tanner, William F., Trigonometric Solution from Apparent Dip, Trans. Amer. Geophys. Union, 37, 231, 1956.

ACKNOWLEDGMENT

Courtesy SHALE SHAKER, Oklahoma City Geological Society, Oklahoma City, Okla.

About the Author

JOHN BEMROSE was born in England and educated at London University, and gained his early experiences in the gravity, seismic, and aeromagnetic methods of oil exploration with The Royal Dutch Shell Group Companies. He worked in The Hague, Dutch East Indies, Venezuela, The Bahamas and Australia. He came to the U. S. in 1948 and joined Sohio Petroleum Company, and is presently located in Oklahoma City in charge of a special projects group. He is a fellow of the Physical Society of London, a member of the European Association of Exploration Geophysicists, American Geophysical Union and the Society of Exploration Geophysicists.

WORLD OIL'S 1957 DRILLING PROGRESS SECTION

The Contractor Picture

SINCE LAST YEAR'S Drilling Progress Issue, drilling contractors as a whole have had to tighten their belts and face the economic brunt of the ills that have beset the entire petroleum industry. The economic pinch began with ever increasing imports, then came the Suez crisis, followed by the Natural Gas Bill. These events and the resulting conditions had the large and small operators alike wary of spending development money that may be hard to recover. Add to this the reduced producing days due to proration and in some localities even the further proration from crude oil purchasers and the economic payout picture is not for extensive drilling operations.

Faced with his customer's problems on one hand, the contractor was handed a further economic blow when an increase in equipment and supply prices hit him—increases, that, except in a few areas, he was unable to pass along to the customer. Do these economic blows spell the end for the contractor?

To answer this WORLD OIL has turned to the men who more than anyone else should have their fingers firmly on the pulse of the contract drilling industry: the national and regional officers of the American Association of Oilwell Drilling Contractors. Here in the next eight pages are their comments and (mostly) optimistic appraisals of the contractor's position—present and future.

Combating the Cost Squeeze

IN THE DRILLING INDUSTRY as in any other industry when an economic depression sets-in about all that can be done is to muster all forces and try to hold the line and weather the economic storm. Due to the inflationary rise in the cost of equipment and the inability of the contractor to replace his old and obsolete equipment at the present depressed drilling prices he must make every effort to maintain the equipment that he has in the very best condition, thereby preventing any major breakdowns.

Management must take the lead in initiating any program, even one of maintenance. His personnel must be instructed and inspired to carry out the program that he establishes. And last but not least management must check to be sure that his program is being carried out in the manner that he intended.

Presented in this Special Drilling Progress Section is one management's way of coping with the maintenance problem. A following article explains one method of sound cost accounting that would be apparent even to the newest crew member.

Concluding this special section are articles on maintenance of some of the more important rig components, factual day-to-day advice that will enable you, the contractor, to get better and longer service from your equipment.

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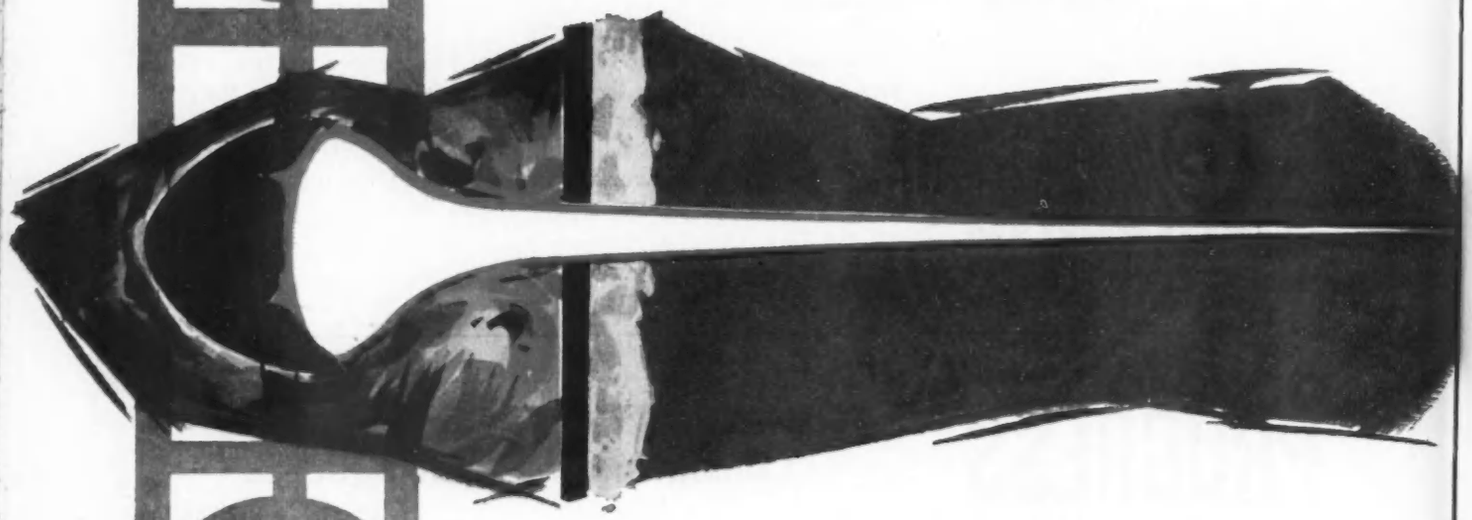

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The Drilling Contractor: Present and Future

This year's drilling slump has caused contractors to tighten their belts and take a long look at the future. How hard have they been hit? What areas show greatest decline in rig activity? What are the factors involved: For the answers to these and other questions, WORLD OIL went to the officers of the American Association of Oilwell Drilling Contractors. Here are their replies.

Jack H. Abernathy
Big Chief Drilling Co.
Oklahoma City
President, AAODC

Brad Mills
Executive
Vice President
AAODC, Dallas

Our Job: To Help Meet Rising Demand

THE DRILLING contracting picture this year has been in line with our January forecast wherein we stated our opinion that 1957 could see a reduction in the average number of rigs operating and that we expected over-all operations to be quite close to 1956 averages—only slightly better, at best. This conflicted with other predictions of considerable increases.

The following reports from the various vice presidents of the American Association of Oilwell Drilling Contractors show that over-all the drilling business has not been particularly good this year. Certainly there are variations in the picture, better business being experienced by contractors with rigs in areas of recently expanded activity i.e., the Four Corners area; the Texas-Oklahoma panhandle area and offshore. Offshore work, however, has levelled off and it appears that enough equipment is available to take care of requirements for some time to come.

Despite some disappointments during the eight months period just ended, we should look to the future with the thought that contractors can and must adjust themselves wisely to such conditions as will prevail in an industry needing a certain number of wells to maintain necessary oil reserves. This may not be easy in spots, but it will be even more difficult if all contractors do not operate on a businesslike basis.

As to future activity, we feel three periods should be considered:

1. Immediate Future—Balance of 1957. We are hopeful that the number of rigs running will, for the first time this year, equal or exceed 1956 levels.

No evidence in sight points to activity approaching the peak of December, 1955, when 3137 rigs were operating. Nevertheless most contractors can expect a reasonably good volume of business during the remainder of this period. Historically, drilling increases in the last half of the year; furthermore the President's action on imports has given domestic producers a measure of confidence, thus stimulating prospecting and development.

2. Intermediate Future—1958, 1959, 1960, 1961. It appears that this period, by and large, will be one of some difficulty—not unlike the first six months of 1957.

Contractors who genuinely work hard at their business will find sufficient profitable work to keep their doors open although funds for expansion, upgrading rigs or for entering into heavier-duty, deeper drilling, will be hard to come by. During these years many contractors will enter successfully into foreign operations. It

should be remembered, however, that the saturation point will be reached within a year or two just as the industry met our customers demands for offshore equipment in about two to two and one-half years.

One factor which tends to improve prospects for contractors toward the end of the period is that of rig availability. On several occasions association officers have expressed the view that the drilling industry has failed to meet its replacement needs in purchases of new equipment, the liquidation amounting to about 150 rigs per year. It was estimated in the early 1950s that about 3600 drilling rigs were ready, willing and able to work. We believe rig shortages would begin to show up should activity approach the 3000 level at this time, and a few more years of reduced activity will see substantially fewer efficient rigs available.

3. Long Term Future—1962 Plus. Predictions in excess of five years are obviously uncertain. Nevertheless, facts are available which give an indication of probable trends. The first and most important factor is increasing consumption. U. S. demand for petroleum and its products historically increases about 5-6 percent per year. Since World War II consumption in the free world exclusive of the U. S. has increased about 12 percent annually. Despite this rapid growth the percentage of the energy requirement of European industrial areas is met only in small part by petroleum and its products.

The recent stupendous discoveries of crude reserves in soft currency areas has stimulated and will continue to stimulate over-seas demand, thus the upward trend of consumption is expected to continue for a number of years.

Although authorities differ, it is probable that U. S. crude oil reserves are now only about 10-15 percent of the total available on this side of the Iron Curtain. Currently, the free world market is about 15 million barrels daily including about 9 million barrels used in the U. S. It has been estimated that if all free countries used oil on the same per capital basis as does the U. S., total demand would be about 140 million barrels daily, more than nine times the current level.

Obviously such extremes of consumption are unlikely in our time. Nevertheless the overpowering reserves and productivity of the Middle East and other areas will appear moderate with respect to requirements should the present trend continue.

We should not lose sight of the importance of our business and our obligation as the drilling segment of the industry. Nearly all of the equipment for drilling necessary wells is in our hands. World consumption of petroleum products almost certainly will continue upward, and we should participate in meeting this expanded demand with an adequate operating program.

The percentage of U. S. wells drilled by contractors has increased to more than 93 percent, up from 68 percent in 1940. This strongly indicates that producing companies do not want to drill for themselves and that future contract drilling will continue to supplant even the small percentage of work still done by producers.

Summing up, contractors who study costs, bid carefully and use all the economic, operating and personnel training facilities available to them through the AAODC, are likely to enjoy better business beginning in four or five years. Some contractors who may be self-satisfied or unwilling to take advantage of every possible aid obtainable will probably be badly hurt.

J. U. Teague
Columbia Drilling Co., Houston
National Vice President, AAODC

If Underbid, Perhaps Your Operations Need Checking

THIS IS A TIME of self-examination for the drilling contractor. On every side we hear drilling contractors complain of the scarcity of work, low footage prices and the high cost of equipment and supplies. The day of doom is surely upon us or fast approaching.

A few nights ago I saw a TV rerun of Will Rogers' old picture, "David Harum." One of his famous quips in the picture was; "you could talk yourself into panic, but you had to fight your way out." How well that can be applied to the contractor today. We can readily admit all the ills we complain of are with us, and are most pressing.

If we look at next week or next month the future is indeed black. But let's raise our horizon a little. What kind of an industry are we a part of? Every economist tells us modern civilization is geared to petroleum. Doesn't the drilling contractor provide the only tool that will find and develop this magic substance? Our population, indeed the population of the whole world, is growing at an explosive rate. If this increased number of people is to be given a higher standard of living, which it certainly wants, isn't it logical that we will need all the energy we can make available, especially oil and gas? We also know that each time we find a barrel of oil, we must look that much harder to find its replacement, whether it is in Texas or Timbuctu. The drilling contractor

then, is an essential part of an essential industry, whose future seems anything but limited.

Contractor problems then, although very acute and painful now, can be looked upon as temporary. Those contractors who are able to solve them or endure them for a time can, I think, look forward to a better day and a stronger industry. This adjustment will not be easy, and some contractors will without doubt be forced out of business.

The contractor who continues to take work below a profitable level is certain to eventually go broke. How much better it would be for him, his creditors, yes; and his customers, to shut his rigs down rather than run them at a loss. It's painful to reduce your working force, and it isn't pleasant to have to admit to your brother contractors that you, too, have rigs idle. But if you shut a rig down, wouldn't you be forced to evaluate your personnel, maybe for the first time in a long while, to be sure you keep the best? Wouldn't you, as a result, have a stronger though smaller working force? If you have to shut equipment down, won't you shut down the least efficient first? If you do, won't you be able to offer your customer a higher quality of service and be in a much stronger competitive position? A small reduction in the number of rigs operated would bring supply in line with current requirements.

In a free economy such as ours (and may our good Lord grant that it ever remains free) the forces of competition will not long permit a profit to be paid on inefficient operations. That is the great safeguard the customer in a free economy has. So if a contractor is to survive through good and bad times, he must operate efficiently.

To be efficient he must have good accounting records and a good accounting system. Only with these tools can he tell what his costs are, where they can be best controlled, what his tax problems are, if he is making a profit, if he is retiring his indebtedness too fast or too slow, or at all. A contractor who is trying to operate today without a good system of accounts is like a man trying to drive a car down a crowded highway blindfolded. He is bound to have a disaster. The AAODC can furnish an accounting manual which if followed, will provide contractors with all the information needed to guide their business. Without it, or a similar accounting system, I don't see how one can hope to survive this trying period, or to profit as he should when the better days come.

Most contractors are capable of handling the actual drilling of a well. However, when consistently underbid by competitors who seem to be providing good service and are keeping their bills paid; check into their method of doing things before charging them with price cutting. Maybe it's you who needs to take a look at your method of operation.

Contractors are in an essential business which has a good future to look forward to. Our present illness is acute but not fatal. Those who observe sound business practices and bid their work to make a reasonable profit, can confidently expect to live to see a happier day.

GULF COAST

Earle C. Hellums, Gracey-Hellums Corp., Houston
Regional Vice President, AAODC

Outlook Is Dim, Offshore Rig Supply Is Saturated

THE AAODC GULF Coast region covers a large exploratory area with diverse problems and factors that affect the drilling contractors' outlook. The contractors' problems are more acute in some parts of the region than in others; however, the outlook is not bright in any area.

There appears to be only two one-rig contractors that have either sold their rig or turned it back to the supply company and gone out of the contracting business; however, there are other contractors trying to sell some of their rigs.

In general, drilling activity is not picking up in this region, however, there has been a recent slight increase in one area. Each contractor must be sure that he is using the best drilling practices and obtaining maximum efficiency from the equipment on each rig. A thorough analysis of costs is necessary, an efficient maintenance program is essential, constant attention to safety must be maintained, and more emphasis must be placed on the development and training of personnel.

Rate of penetration has not increased recently except on some rigs where the cost of larger pumps and more horsepower could be justified. Some improvement could be made through use of larger equipment in some areas, if the contractor could see how he could pay for it in the face of rising costs and declining income.

In general, it has been necessary for the contractor to absorb the recent cost increases. There are a few instances where the companies have permitted adjustment of rates to cover part of the increased costs; but, in general, where the contractor has included the increased cost, he has not received the work.

One area reports very little profit if any. Prices are so tight that if they make a little on one well, they may lose it on the next. Many contractors in this area are trying to get well-interest deals where they can try to get

their actual direct cost and gamble on ultimately discovering enough oil or gas to be successful. This is not a healthy solution. If you apply the discovery well ratio; for every lucky successful contractor, there will be many that go broke. Another area reports that, generally, a profit is still possible, but that it is less than last year; and, if the present trend continues for another year or so, their profit will vanish. Considering the entire region, it seems that it is very hard to show any profit if proper depreciation rates are used. Apparently, most contractors are finding it difficult to realize the inevitable influence of inflation on the replacement cost of their equipment.

Unless there is a reversal of the present trend, the future of the drilling contractor in most areas of this region does not look very good. However, a contractor by nature must be an optimist and hope his problems can be solved through hard work on his part and the cooperation of the oil producer.

The offshore area has not been included in this report, as it does not fit the general picture. However, the outlook there does not seem to be as good as last year. Opinion seems to be that there is no expansion in view and that work could possibly decline slightly.

NEW MEXICO AND WEST TEXAS

M. M. Brantly, Brantly Drilling Co., Midland
Regional Vice President, AAODC

Activity Down; Contractors Can Improve on Operations

DRILLING ACTIVITY in the Permian Basin for the first six months of this year was considerably below normal. The lack of activity, combined with the price structure, hurt every contractor to some degree, but it, in itself, was not severe enough to cause failure of any substantial contractor.

At the present time, activity is picking up in this area, but the weekly fluctuations make it extremely hard to establish a trend. The general feeling seems to be that the last half of the year will see an increase in activity.

Almost any contractor can improve his operations with respect to safety, rig maintenance, improved drilling practices, improved cost accounting, and additional training of personnel. The amount of improvement that can be made, varies greatly with the individual contractor. Many have been working steadily along these lines for years, and as time goes on improvement becomes harder and harder to obtain. There are others who could, by additional work, show a great improvement in their position.

It is normal and probably necessary for maintenance items to be neglected when work is scarce and prices are poor. Temporary saving made by a decrease in maintenance, will, in the long run, be quite expensive to the contractor. Preventive maintenance is more economical than premature replacement.

Most contractors constantly work to improve their drilling practices, but in many cases are handicapped by lack of sound engineering thinking. With the equipment currently available, the big improvements in drilling practices have been made. The problem now, is to find ways of constantly making minor improvements.

There has been very little increase in the rate of penetration in the Permian Basin in the last few years. We are fast approaching the limits of the equipment in use. The development of chert bits has greatly increased the percentage of time on bottom in extremely hard formations. The experimenting with air and gas drilling indicates that if certain inherent problems can be overcome, it offers the best opportunity for a very great increase in the rate of penetration. Unfortunately, to date, this method has a very limited application.

Until recently, most contractors were attempting to absorb the recent price increases passed on by the supply and equipment companies. It would appear impossible for these increases to be absorbed by the contractors. A footage price increase is not yet apparent, but it is certain to come within a very short time.

Before these recent cost increases, it was possible for a contractor, with efficient operations, to make a small profit. If footage prices increase to cover these cost increases, this can still be true. It is seldom that a contractor makes sufficient profit on several wells, to cover the cost of a serious fishing job on one well. Most bids are based on the surmise that no trouble will be encountered. This is wishful thinking.

There should be a considerable amount of drilling activity in the Permian Basin for many years to come; and the well-run contracting companies in the area should have a fairly good future. Many of the excess rigs in the area are approaching obsolescence and new rig sales have been low for several years. As the surplus rigs in the area are retired, rigs properly maintained and kept up-to-date, should find more work available and probably at a fairer price.

The contracting industry historically, has its ups and downs. We are now in a severe down period, but shortly the industry should be pulling out of its slump. There is no reason to expect a boom, but the probabilities look good for a stabilization of the industry on a higher level than at present.

ROCKY MOUNTAINS

Will I. Lewis, Jr., Will I. Lewis Drilling Co., Denver
Regional Vice President, AAODC

Denver Basin Declining, Four Corners Area Up

CONSIDERING THE whole Rocky Mountain region, the drilling activity is picking up in most areas except for the Denver Basin. Here the drilling activity has been on the decline. As might be expected, the Four Corners area is the most active. In the face of this and with the price structure what it is, one contractor is known to have quit the business while others have been trying to sell their equipment.

In this area where transportation and climatic conditions present new problems, contractors are forever on the lookout for new ways of improving drilling practices or drilling methods. In recent months, improved drilling practices have aided contractors in many of the areas. The penetration rates have been increased in quite a few of these areas. In Montana an air hole was drilled with a penetration rate 200 percent better than a mud-drilled hole 23 miles to the west. In the Four Corners area, larger more powerful pumps are aiding contractors in increasing their penetration.

The recent price increases in equipment and operating supplies have been offset to some extent by certain companies adding a straight 7 percent to their depreciable day costs as well as to their supply and maintenance costs and have thus been passing the increase on to the operator. In this area it is definitely possible for some of the contractors to make a fair profit. Prices are still too low in the Four Corners area, or else drilling practices are not what they should be. The day rate prices here are the same despite the price raises.

However, the future of the drilling contractors business in the Rocky Mountain region seems good if sound business policies are utilized to the utmost. Now, more than ever before, a contractor must avail himself of all services, especially those offered by the AAODC. He must actually look over a location; know his employes' and his equipments' limitations and capabilities. Some companies are relying more on the service a contractor can give than on the actual price that is charged.

It is the opinion of many that large reserves still exist in the Rocky Mountain region and money can be made if contractors continue to think out their problems and arrange their finances on each and every bid. The general picture is not for a boom, but for steady competitive work at prices that should produce profit, via sound economical drilling practices.

CALIFORNIA

R. C. Sharp, Vice President, Kellogg Overseas Corp., Compton, Calif.
Regional Vice President, AAODC

Reduced Activity, Too Many Rigs, Prices Depressed

THE CALIFORNIA DRILLING industry is faced with the same basic problems as those confronting contractors throughout the U. S. The problems are interrelated and three in number:

1. Reduced drilling activity
2. Oversupply of rigs
3. Depressed prices.

While not new, they are perhaps more acute today than at any time in the past. Judging by the national averages of rig activity, it appears that California has been hit harder than any other area, or at least our recovery is much slower in starting. During the first six months of this year the average rig activity of contractor-owned rigs in California averaged only 57 percent. Any industry would be hard pressed to support an idle capital investment of 43 percent and still maintain a profit on the active 57 percent.

A number of contractors have chosen to sell their rigs in the face of greatly reduced or no profits. In order

to stay in business we must follow a sensible replacement policy for equipment. This has become increasingly difficult due to the depressed price structure. There have been very few new rigs purchased here in recent years, and the supply companies make some rather long deals on their oversupply of used equipment.

Trying to improve our position by more efficient operations is a never-ending process that involves improved equipment, better trained personnel and more realistic cost accounting. All of us who intend to stay in the business of drilling oil wells are constantly working on these three problems. At the moment, perhaps, the most important of the three is the matter of cost accounting; not because equipment and personnel are any less important, but because none of us can afford new equipment at the present time and there is an adequate supply of trained drilling crews currently available.

Suffice to say that the curve of increased penetration rate as applied to California seems to be leveling off because of: (1) drilling deeper wells, (2) drilling more directional wells, and (3) the economic impossibility of purchasing heavier and more powerful rigs.

Most of the contractors in California have adjusted to the recent increases in the cost of labor and supplies in the same manner as contractors throughout the country. If we are realistic in our accounting, we passed it on to our clients. If not, we absorb the increases and thereby further reduce or eliminate the profit margin.

If a contractor has maintained his equipment at an efficient operating level and that equipment is pretty well depreciated, and if the contractor has a strong and loyal group of good drilling hands, we would say that he can operate at today's prices at a low profit, but still a profit. Certainly, in California, it appears impossible to purchase a new rig and compete with well-maintained used equipment at today's prices.

What of the future? An informal poll of a number of the largest contractors indicates a very pessimistic outlook. The problem again is one of economics. Even though California has become a "have not" state in the matter of crude production, the cost of finding and producing oil here has put us in an unfavorable competitive position with oil produced in other states and overseas. We still are going to drill a lot of wells in California, but anyone considering entering the drilling contracting business for the first time had best look to greener pastures.

ILLINOIS, MICHIGAN, INDIANA AND KENTUCKY

Don Slape, Don Slape Drilling Co., Olney, Ill.
Regional Vice President, AAODC

Rigs Down and Out, Strike Of Crude Purchasers Hurts

WITHOUT BEING PESSIMISTIC or optimistic, I must say that drilling contracting in this part of the country is very bad, and probably will not change for the better in the near future.

Numerous contractors in the Tri-State area have gone out of business. Some have been complete failures; others have quit and stacked their rigs; others are attempting to sell out but can find no buyers.

There seems to be no immediate let-up in the decline. Active rigs in the Tri-State area are at a low equal to the lowest number for this year.

In addition to the many other problems that the drilling industry faces, one of the principal crude oil purchasers in this area has had a crippling strike. As a result, the producers are unable to move their crude oil and this is having a decided influence on drilling activity.

The contractor has done virtually everything possible to improve the technology, skill and safety of the business. This has been necessary to maintain their position and stay in business.

Attempts to increase the rate of penetration have been made to try to offset the recent increases in costs of drill pipe, drilling bits and other equipment. It is doubtful that sufficient gains can be made with the present equipment. Some means must be found to increase the rate of penetration and improve our economy, as we are finding it almost impossible to convince our customers that we are entitled to an increase in drilling prices.

Some contractors are not currently realizing their actual out-of-pocket costs for their services. This condition makes it almost impossible for a good contractor to get prices that will show him a reasonable profit. The majority of good contractors are operating on the theory that if they can get prices sufficient to cover their actual drilling costs, they may be able to remain in business until the present situation has been adjusted.

My opinion of the future of the drilling contractor in this area is that there is a possibility that if one can hold on long enough, conditions will adjust to a point where, at some future date, a contractor might be able to remain in business and show a reasonable profit on contract drilling. Under present economic conditions in this region, the future of the drilling contractor is not very bright.

CRETACEOUS AND TERTIARY BASINS

Herbert Woolf, Woolf and Magee, Tyler, Texas
Regional Vice President, AAODC

Mississippi Offers Some Hope; Portable Rigs Used

THE DRILLING contractor's outlook in this region is anything but rosy. There has been a decided slow-down in drilling activity in the whole area since about October of 1956.

Mississippi does offer some hope for work in the 12,000-foot and below depths. Considerably more work will result if the three recent deep discoveries prove to be fields. Otherwise —unless something unforeseen develops—there is not too much to look forward to in south Arkansas, north Louisiana or East Texas.

Practically the same number of rigs are running now as in January. It seems that the lack of available money, lack of acceptable prospects, and principally the lack of incentive due to lower allowables have the drilling business at its lowest ebb in several years.

Some area contractors sold out or went out of business in the early part of the year, but I could not say that the cause is directly attributable to the lag in drilling.

There is always room for improvement in drilling practices, safety and personnel relations. The rate of penetration has increased very little, if any, in the last six months. We have no known new methods or new equipment. There has been a slight tendency in our area toward trailer-mounted rigs for work they are capable of doing. This is not for increased rate of penetration, but to cut down moving time and expenses.

There are so many drilling rigs down in this area that I would suspect that many contractors will try to absorb a part or all of the increase in operating costs. In my opinion, this is not going to be possible, because most current contract prices were figured on depreciation—or less—before the recent increases in costs.

Until there is a greater demand for domestic crude oil, the future of drilling in this area looks rather dim. Other than offshore drilling, I haven't heard of anybody attempting to get into the drilling business in the last year. At present there are numerous drilling rigs, and even some drilling firms, for sale with no takers.

CENTRAL MID-CONTINENT

Frank E. Frawley Frank Frawley Drilling Co., Tulsa
Regional Vice President, AAODC

Activity Up . . . Outlook Good for the Larger Contractors

TO A LIMITED extent, drilling activity now seems to be increasing in this area (Central Mid-Continent).

I do not personally know of any contractor in this area who has gone out of business as a result of the slow-down in drilling early this year.

Drilling practices, safety methods and maintenance procedures can always be improved on, to the benefit of every contractor. Noticeable gains are made only over the long haul, however, and there is no recent marked improvement in drilling speed. With the present equipment, it would appear that we have reached the maximum rate of penetration.

Most contractors have absorbed all labor and equipment cost increases. A very small profit is still possible, if no unusual fishing jobs or blowouts are encountered.

It is my belief that the long-range outlook—that is, the next five or ten years—should be very good for all the larger drilling contractors and most of the smaller concerns.

NORTH AND WEST-CENTRAL TEXAS

J. D. Huffaker, F. W. A. Drilling Co., Wichita Falls, Texas
Regional Vice President, AAODC

Only Slightly More Than 50% of Active Rigs Going

IN RECENT MONTHS the drilling contractors in the north and west-central Texas area have found it increasingly difficult to keep the rigs operating. There have been only slightly more than 50 percent of the total rigs in this area running to this date. At the present time there appears to be a slight increase in the drilling activity, and it is hoped that drilling activity will continue on a higher level throughout the rest of 1957 and into 1958.

At the present time contractors have been forced to watch every item concerned with the efficient operation, and most contractors have tried every conceivable idea that they can think of to help increase their penetration rate. Due to the rising cost of materials, labor and services, it has been increasingly difficult to break even—let alone show a profit.

However, it is believed that the contractor with a good cost accounting program and one who maintains good contractor-operator relationship will still be able to stay in business and possibly make a little money in this area.

WELL SERVICING

W. C. Fatjo, W. C. Fatjo Drilling Co., Tyler, Texas
Vice President, Well Servicing, AAODC

Servicing Firms Benefit From AAODC Memberships

THE PRINCIPLE lines of work performed by the well servicing firms who have memberships in the AAODC are rod and tubing jobs, workover and deepening operations, and some do shallow and slim hole drilling. Those who do shallow and slim hole drilling have found that it is not too profitable to continue in this practice because of the tremendous cost of changing from workover to drilling.

The slowdown in drilling operations has worked a hardship on some of the well servicing companies due to the fact that drilling rigs have been put in the workover and deepening operations. Also the cut-back in producing days have hurt because the cost of working over these wells are studied very carefully. The cost of equipment and operating materials have also worked a hardship on the well servicing firms, as they have not been able to advance their prices due to the decline in operations.

The advantages to a well servicing firm to be associated in the AAODC are to associate themselves with a group of men that are constantly working on safety, cost accounting, transportation, insurance, drilling practices such as toolpushers manual, drilling reports, contract forms, drilling schools, and completion practices.

—The End

What is management's role in maintenance?

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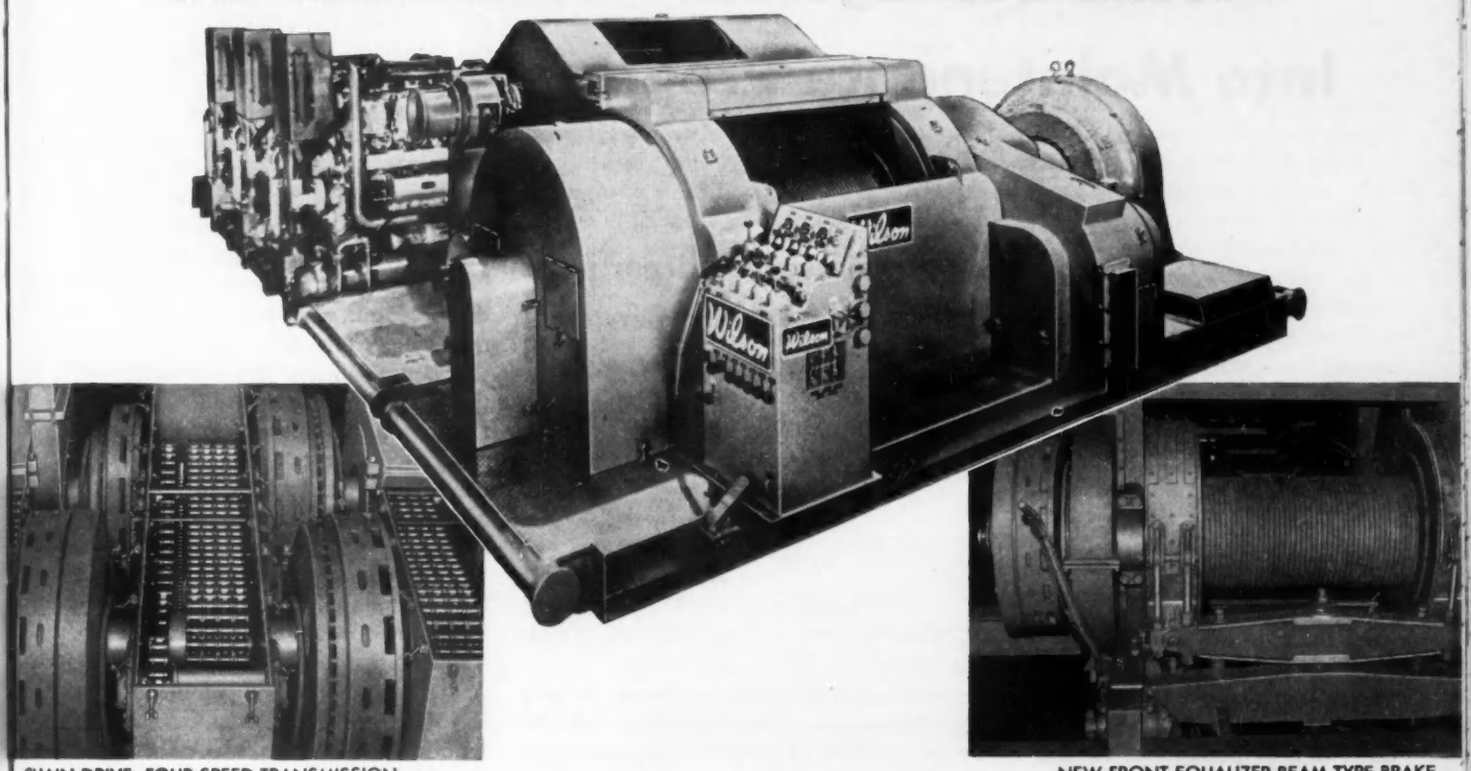

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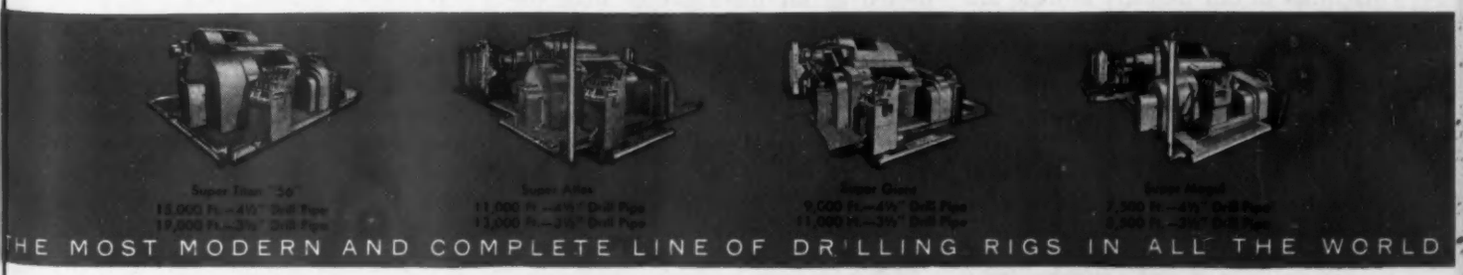

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How Management Fits Into Maintenance Program

Do you have a maintenance department or a "fix-it" shop? Trained personnel can decide this question for you.

By R. J. Bromell
Assistant to the Vice President
Great Western Drilling Co., Midland, Texas

A MAINTENANCE department must repair equipment and keep downtime, due to equipment failure, to a minimum. The latter is the most important and by far the most complicated.

A review of the manner in which equipment is kept in operation is indeed revealing. The term "maintenance" is deliberately avoided here since no attempt, till recently, was made to maintain equipment. Harsh words? Perhaps some will take issue with this point of view but the majority will have to admit that "maintenance departments" have devoted more energy toward being "repair departments." Maintenance men were, and still are in most cases, repairmen or even "fix-it-men." These men who so desperately attempt to keep the machines of our industry moving are not be blame. Their dilemma results from the failure of management to fully comprehend the maintenance problem and take the necessary steps to correct it.

Equipment changes during recent years have made maintenance more difficult for the untrained crewman, driller and rig supervisor. Before shrugging this statement off, it is strongly recommended that a test on rig equipment be given to the best drilling department personnel in any organization. The examination should be made from questions on each piece of equipment as asked by the manufacturer of that piece of equipment. Many of our complex machines are being operated by men who have failed to inform themselves about new developments except through costly self education by experimentation. The ideas that form about the operations of equipment as a result of such self education are sometimes good, sometimes remarkable, sometimes astounding, often times costly.

Many men, particularly those who have worked themselves into positions of responsibility, seem to think it a sign of weakness to ask questions. After all, he's the boss, and the boss knows everything. This attitude is reflected in far more people than the drilling industry cares to admit. Formal training in the drilling industry has been nil and it is agreed that it takes years of experience to develop a good drilling supervisor. There is no reason to assume that these years of experience make a man all wise. His experience needs to be supplemented with training of a formal nature. Years ago this was not so, but in today's competitive atmosphere he must be businessman, personnel man, technician and half mechanic.

An incident of some years ago typifies the attitude of the often referred to "good well-man." The engines on a rig were overheating with subsequent cracked heads and manifolds when the man in charge was told that the liners in his pump were too large. It was pointed out that smaller liners would let the engines speed up, thus develop more power and actually pump more fluid and not overload the engines. Pondering the information for sometime, he remarked, "The liners aren't too big, the engines are just too small." An astute observation; after all, he was the boss and wouldn't dare admit he might be wrong. The liners remained, the engines were "burned up" and the owner paid the bill. Engineers from manufacturers, suppliers and service companies know that this attitude does exist; however, it is not nearly so prevalent as several years ago.

Maintenance costs which represent approximately 35 percent of the daily operating cost are available from only a few companies which maintain adequate records. This is a reflection on the management of many companies who are unable to present the necessary data which would enable them to study one of the most costly phases of their operation. Are the published figures or traditional operating costs taken for granted as the cost of maintenance, or should the high ratio of maintenance to overall operating cost incite corrective action? To accept the high cost as an inescapable part of the business would be an expression of self satisfaction in that nothing can be done to improve the present method of operation. This attitude would be pure folly since not only does the maintenance figure itself offer an interesting challenge but the related problems add even more incentive to accept that challenge.

Webster defines: Maintain—to hold or keep in a state of efficiency; Repair—to restore to a sound or good state after decay or injury. These definitions leave no doubt as to which situation is most desirable. How to "maintain" and thus minimize "repair" to equipment requires considerable investigation. What are the exact costs for maintaining each type of equipment? What similarity exists between equipment failures? What started the failure? Could steps be

taken to prevent failures? Are we repairing or replacing? Are operating crews aware of causes of failures and their costs? Is equipment being used within the limits for which it was designed? With whom should the responsibility for failure and damaged equipment be vested? These questions only hint at a few of the many pursuits an investigation must follow. Some lead to technical personnel for answers, some to accounting, some to the crews and supervisors, and, of course, some to the maintenance department. As the picture takes form it becomes obvious that maintenance is a problem of many people and departments. Maintenance then must rest with management. Management must establish policies regarding the relationship of these people and departments to each other in the composite job of maintaining its equipment.

"Too elaborate and complex to be practical." "Can't see how so many people fit into the picture." These typical comments in regard to establishing a complete maintenance program do not consider the true source of high maintenance costs; personnel shortcomings. The crews who operate the equipment are present 24 hours per day and therefore are the only ones actually in a position to directly "maintain" the equipment. Their degree of success depends upon the scope of their training and sense of responsibility. The remaining departments, or service companies, assist in completing the maintenance program.

The cost accounting department is the logical place to get information about maintenance costs. If properly set up, costs on individual pieces or types of equipment can be easily reviewed. These costs can be used to correct designs for future operations. Regardless of how a maintenance program is set up, the cost department is essential as a means of measuring progress.

An engineering department aids maintenance by furnishing trained men to translate cost data into operating practices. Equipment failures need investigation to provide the proper information for future design or modification. New equipment, both products and designs must be tested by those qualified to analyze the results. In addition to studies on equipment, engineers should recommend liner sizes for pumps, hook loads, electrical loads etc. to keep within design limits of equipment. In certain cases it may be necessary to require more of equipment than that set forth by the manufacturer. An engineering recommendation should be obtained in these cases to minimize possible damage.

There can be no successful maintenance program without competent personnel. If a company is to have competent personnel, it must have good personnel records and a comprehensive personnel program. All operations depend on people and the results reflect the ability and attitude of those people. This means that management must provide facilities for training personnel, both drilling crews and mechanics, in how to maintain and repair equipment. A comprehensive program based on classification of personnel into various job levels as an incentive program is essential. The security of working to a higher paying job with accompanying job priority lends much to establishing the desired sense of responsibility in the employe. This system based on competitive examinations and practical demonstration of ability gives a sound basis for promotion, assuring the right man for the job.

Such a program simplifies the administration of the remaining company benefits such as hospitalization insurance, vacations, bonuses etc. since accurate records are constantly maintained. As the average length of service of employes, particularly rig crews, increases, the maintenance program improves.

The maintenance department performs the usual task associated with its name—it repairs equipment. In addition, it compiles data and makes recommendations on overhaul periods, junking of equipment or needed equipment changes. Aside from the operating end of the business it sets the standards for maintaining equipment and conducts the schools necessary to train personnel. It sends representatives to manufacturing plants to learn proper methods of operation and repair. As a quality control department it conducts periodic inspections of equipment to insure proper performance of duties by personnel and to find equipment which should be removed from service for repair as insurance against breakdowns. The note in regard to personnel performance ties in with the personnel records where inspection results are made a part of the responsible person's record.

Drilling department supervisors should base all transfers and promotions on personnel records. New men start at the bottom and must come through the ranks to hold down any rated jobs as motorman, derrickman, driller or rig supervisor.

Additional training of the crews in technical knowledge is provided by the drilling superintendent and supervisors. They also should take every opportunity to improve employe relations. It is obvious that good employes on the rigs make the supervisors' job easier.

A maintenance program encompasses many things, as pointed out above, but most important, it requires the changing of attitudes. Attitudes are developed through careful study, planning, training and effort on the part of those attempting to achieve a goal.

The responsibility for establishing the program through which all the above can be accomplished rests with an alert management. This is truly management's role in maintenance.

Webster defines maintenance: "to hold or keep in a state of efficiency"; repair: "to restore to a sound or good state after decay or injury." There is no doubt as to which is more desirable.

Keep going for a sure-fire cost accounting system

FIGURE 1—Pressed steel flanges prevent enlargment of hole and insure longer life of reel.

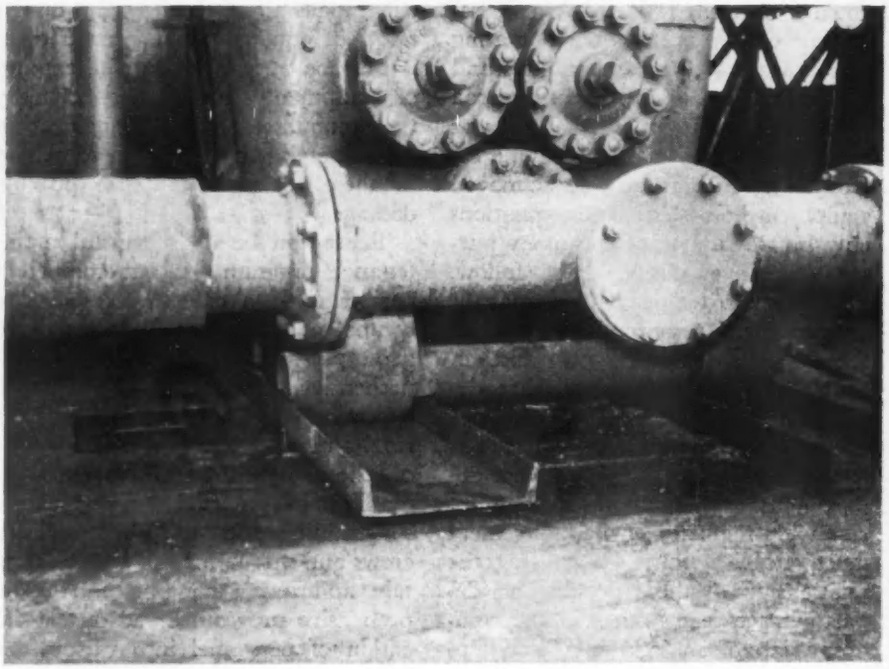


FIGURE 2A—Here is another method of assuring positive alignment of the pump. Channel iron secured to mats provides guide; also simplifies moving the unit forward or backward in adjusting belt tension.

COMBATING THE COST SQUEEZE

Here's a Cost-Control

By Dan Duncan, Consultant
Los Angeles, Calif.

IT IS COMMON knowledge that drilling contractors for some time have been caught in a squeeze between the constantly rising costs of the drilling operation and the static footage rates.

The only recourse for contractors has been to make a concerted effort to reduce operational and maintenance costs and increase their drilling progress.

In the lush days of contracting, making hole was the main consideration and profits usually were more than sufficient to take care of the cost of the operation. In present day contracting, the reduction of costs is as important as making hole if the operation is to be successful and show a profit.

Many contractors are confident that they are doing everything possible to reduce costs commensurate with maintaining the best possible drilling progress. However, in practically every cost analysis definite and sizeable progress is possible.

Cost analysis and reduction should be a full-time job for at least one competent individual in any contracting organization regardless of its size.

To tackle this subject of cost reduction, it is assumed that the contractor maintains an adequate system of cost records as set up in the AAODC cost accounting manual. It is of utmost importance that he know his daily average costs on a per-well or annual basis for each of the 22 principal items of rig costs—these 22 items being the most susceptible to cost reduction.

Secondly, sound, common sense daily rates should be established for each of the 22 items of rig costs. These estimated daily costs, which may be termed standard costs, should reflect the age and condition of all the components of the rig as well as the current cost of parts and services. These standard daily rates as established should be a target for the entire organization to strive to attain, or better still, to improve upon.

When the actual daily rates are determined after the completion of the well, it is usually noted that the difference between actual daily costs and the standard daily costs, in practically

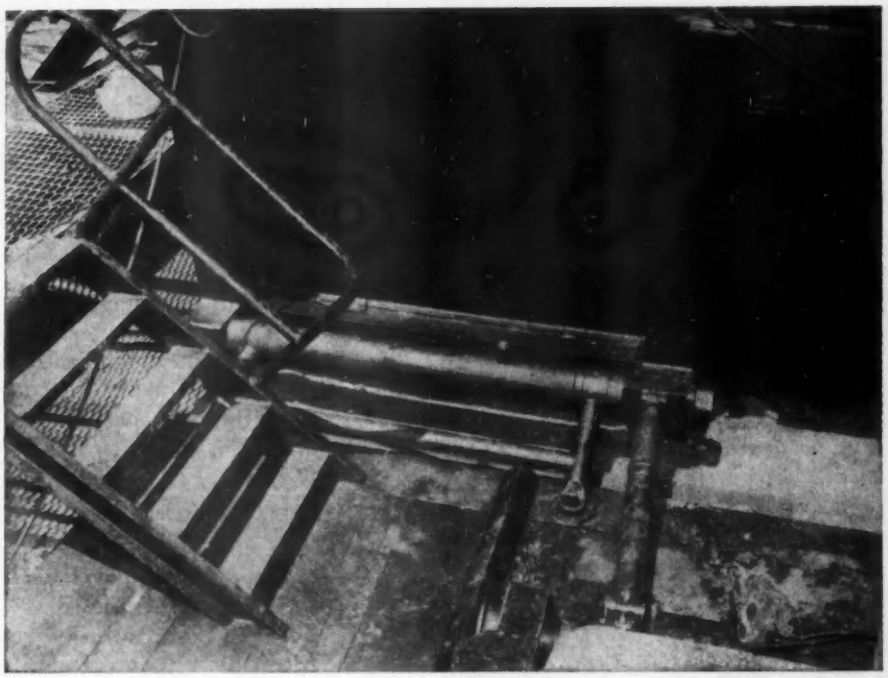


FIGURE 2B—Spacers and tapered pins assure positive spacing and alignment of mud pump mats and rig substructure; save costly crane and A-frame time when rigging up. Initial cost offset by saving.

Program That Works

all instances, run into sizeable figures. Something can be done about this excessive cost and the cost reductions entered in the profit side of the ledger.

Table 1 is a tabulation of a cross-section of actual rig costs for 331 operating days in a 12-month period. It may be considered representative for a rig of 1500 total horsepower driving both pumps from the compound and operating in California. These figures do not include labor, supervision, depreciation, bits and reamers, fuel, fishing tools or special services.

This table represents the results on an average rig. Other rigs may show either lower or higher costs regardless of the total horsepower involved.

It is obvious that in a cost reduction program on the above rig, the individual items of excessive expense should be tackled in the order given, i.e. (1) Mud pumps, (2) Chain and V-belts, (3) Wireline; etc. The order of importance of each item cost-wise will vary from rig to rig. There is no set pattern of excessive costs.

While the above costs represent the average for 12 months of operation—perhaps this average should be extended to represent an 18-month period so that the purchase of a drilling line, or the overhaul of an engine, pump or draw works would not unduly disturb the average, but would still reflect as closely as possible the current cost picture on parts and services.

To show the importance of devoting plenty of time and effort to a program of cost reduction, total cost records of a few representative rigs are shown in Table 2. The horsepower column indicates total horsepower on both draw works and independent pump drives. Under the column; excessive cost per day, the difference between the actual cost per day of all 22 items of expense and the established or standard costs, is given. The last column projects the total savings that could be accomplished for total days of rig operation in a 12-month period, if the actual costs were trimmed down to the standard daily rates.

It should be clear from this table that a cost reduction program is an excellent investment with sizeable potential savings as the reward.

A contractor running a number of rigs should attack first that rig which is most out of line cost-wise. Those

TABLE 1
Twenty-Two Major Items of Rig Expense Where a Cost Saving Could Be Affected

ITEM	Actual Daily Costs	Standard Daily Costs	Over	Under
1. Mud Pumps	$ 52.10	$ 32.00	$20.10	....
2. Chain and V-belts	23.07	10.00	13.07	....
3. Wireline	35.14	25.00	10.14	....
4. Drawworks	25.50	17.00	8.50	....
5. Major drill pipe repairs	29.07	23.00	6.07	....
6. Incidental trucking	18.64	14.00	4.64	....
7. Electrical	8.36	4.00	4.36	....
8. Oil and grease	19.89	16.00	3.89	....
9. Shaker repairs	5.28	2.00	3.28	....
10. Auto expense	6.70	5.00	1.70	....
11. Rig supplies	25.47	25.00	.47	....
12. Table, slips and elevators	10.12	10.00	.12	....
13. Pipe dope	3.60	3.50	.10	....
14. Valves, fittings, linepipe	5.94	6.00	....	.06
15. Other equipment	3.16	4.00	....	.84
16. Rotary hose	4.42	6.00	....	1.58
17. Compound and transmission	6.38	8.00	....	1.62
18. Blocks, hook, crown, swivel	3.80	6.00	....	2.20
19. Engines	26.31	30.00	....	3.69
20. B. O. P. repairs	.28	4.00	....	3.72
21. Drill string	7.92	12.00	....	4.08
22. General Maintenance	5.20	13.00	....	7.80
Totals	$326.35	$275.50	$76.44	$25.59

Net total—excessive costs per day—$76.44 minus $25.59 or 50.85 per day.

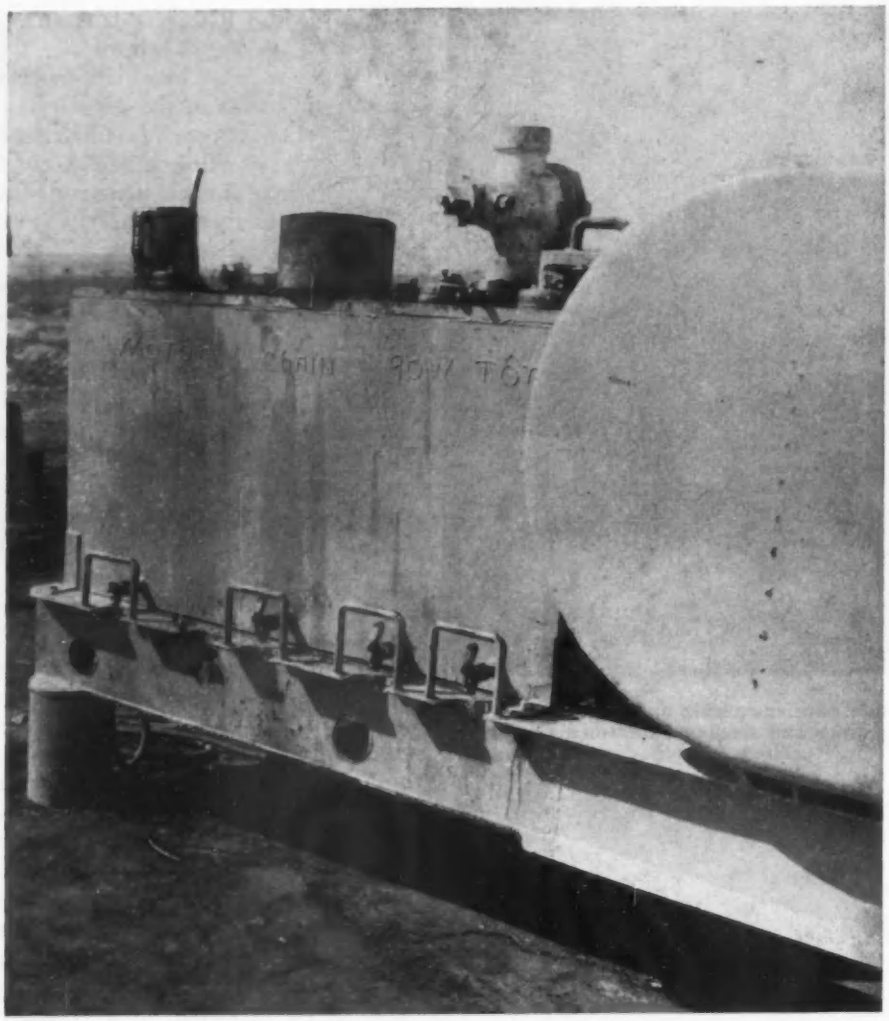


FIGURE 3—Drum deposit charges are kept to a minimum and unnecessary changes of lube oil brands, when moving to another operator's location, are eliminated by using simple, easily moved compartmented tank. Properly labeled so compartment contents are known, lube oils so handled are kept clean and free of contamination.

items, most out of line cost-wise, should be given determined attention.

The subject of cost reduction is so broad that it is impossible to concisely cover the hundreds of considerations involved in one article. However, it may be well to cover say one of the 22 items of rig expense such as drilling line costs, which on most rigs may be of intermediate importance cost-wise. If we go over this subject with a fine-toothed comb, we may come up with some interesting facts.

TABLE 2
Savings That Could Be Affected If Standard Costs Were Met

Horse-power	Operating Days	Excessive Cost Per Day	Total Excessive Cost
1250	95	$ 93.00	$ 8,835.00
1200	58	183.00	10,614.00
1000	104	—5.00	—520.00 (Cost advantage)
1350	255	62.00	15,810.00
900	317	55.00	17,435.00
1200	331	39.00	12,909.00
1100	326	44.00	14,344.00
1200	348	59.00	20,532.00
1500	331	51.00	16,881.00
1200	272	72.00	19,584.00
600	226	47.00	10,622.00
1300	100	123.00	12,300.00
1800	350	68.00	23,800.00
600	310	68.00	21,080.00
1200	281	32.00	8,992.00
2200	278	76.00	21,128.00
1500	339	9.00	3,051.00

First, select the size drilling line for the horsepower on the draw works and the range of work to be performed.

Also, in conjunction with the above, select the proper size for the spool diameter of the main drum; as,

30-inch minimum spool diameter for 1⅜-inch wire line.

24-inch minimum spool diameter for 1¼-inch wire line.

20-inch minimum spool diameter for 1⅛-inch wire line.

16-inch minimum spool diameter for 1-inch wire line.

The sheaves in the crown and traveling blocks should be of an adequate diameter for the size line selected. This must be a practical consideration and the following yardstick should be followed:

54-inch O.D. sheaves minimum for 1⅜-inch wire line.

48-inch O.D. sheaves minimum for 1¼-inch wire line.

42-inch O.D. sheaves minimum for 1⅛-inch wire line.

36-inch O.D. sheaves minimum for 1-inch wire line.

It is a definite advantage to have the crown fast sheaves the next size larger than the diameters indicated as they will reduce the effect of the bending stresses at the high speeds.

Maintain the sheave grooving in good condition and in accordance with API specifications.

Do not be tempted to run the drilling line in oversized grooves as for example, 1⅛-inch wire line in 1¼-inch grooving, if costs are to be kept at a minimum. A worse condition would be to run 1⅛-inch line in 1¼-inch crown sheave grooving and 1⅛-inch traveling block sheave grooving for the line flattens going over the crown sheaves and is pinched going over the traveling block sheaves. A recent example of this practice, on one rig, ran wireline costs 40 percent above normal.

- The drawworks drum should be grooved.
- A fast line stabilizer or spooler should be used.
- Roller turnbacks should be mounted on both ends of the drum.

If the deadline slaps the mast girts, install a deadline stabilizer. A broken wire on the deadline can mean the loss of several hundred feet of line through progressive deterioration by the time the line is moved into the active part of the reeving.

On drawworks supported independently of the mast substructure, be sure that the drawworks is level with the mast substructure. Otherwise excessive fleet angle on one side or the other will be injurious to the line.

In rigging up, try to get the center line of the drum to line up as closely as possible with the center line of the crown fast sheave. Many rigs in operation today have the deadline anchored on the wrong side of the rig, giving a bad fleet angle.

Rotary tables are available today in the larger sizes which allow an

optimum positioning of the drawworks drum because of their shorter center distances. With shaft table drives, the center of the drum can be precisely lined up with the center line of the fast sheave.

Keep wireline ton mileage records. They will help to catch weak spots in wireline service.

Maintain a good program of moving and cutting wireline based on the ton miles per trip. The use of longer wirelines, up to 5000 feet in length, is paying off in reduced wireline costs. Even longer lines, up to 7500 feet in length, are being considered.

Adhere to the recommendations of wireline manufacturers for care of the wireline from delivery to retirement.

When specifying a new rig, do not overlook the definite advantage of a long drum for decreasing wireline costs.

Confine operations as far as possible to the use of eight lines for drilling. Wireline costs pyramid upward when excessive layers of line are run on the drum.

In general, wire center wirelines should be used exclusively in the 1⅛-inch and larger sizes when the drum spool diameters are within the above recommendations. This will minimize the crushing effect on the wireline and will result in greater service per wireline dollar.

Use the pressed steel flanges available for the drilling line reel for they act as wear flanges and protect the bore in the wooden reel (Figure 1). With the longer and heavier wirelines now in use, the reel otherwise may not last through the life of the line. The writer recently inspected some reels, originally holding 5000 feet of 1¼-inch wireline, in which the unprotected wooden bores had been worn to several times the original bore diameter, yet the wireline itself still had considerable remaining life.

A recent wireline service survey of one company's rigs was made with the results predicated on adherence to the recommendations cited above and the attainment of a reasonable ton-mileage, viz:

1¼-inch wireline—12 ton miles per foot of line.

1⅛-inch wireline—10 ton miles per foot of line.

1-inch wireline—8 ton miles per foot of line.

Anticipated results were for a 12-month period with the rig in service 70 percent of the time (See Table 3).

The potential savings shown on Table 3 may appear to be nominal. However, this is but one of 22 divisions of rig expense with many of the other divisions being capable of far greater savings.

A cost reduction program is a cumulative thing. The important point being to attack every phase of rig expense with the same care and thoroughness as indicated above for wireline service. In Table 1, the total excessive cost indicated a potential savings in one instance as high as $23,800. This figure could very well mean the profit for one year of operation for this rig.

A discussion of cost reduction on the above divisions of rig expense would not be complete unless the practice of preventive maintenance were emphasized. This means catching troubles while they are minor; before they develop into major and costly failures. It applies primarily to engines, mud pumps and components of the power rig itself. It means shutting down an engine at the first back-fire or sign of trouble and allowing the mechanic to thoroughly check it. This applies to mud pumps and hoist, where major failure, an expensive shop job, and loss of the use of the equipment during repair. Preventive maintenance in most instances can be employed without shutting down drilling operations.

As an example: Rig A, with 1800 total hp and six engines, operated 350 days in one 12-month period. Actual engine costs averages $60.71 per day against a $36 per day standard cost. Total actual cost was $21,247.48 for the above period. Preventive maintenance was not practiced on this rig.

Rig B, on which preventive maintenance was practiced—had 1500 total hp and five engines and operated 331 days in the same 12-month period. Actual engine costs averaged $26.31 per day against a $30 standard cost. Total actual cost was $8,703.57 for the period.

Rig A's engine costs were $12,543.91 greater than those on Rig B. The engines on both rigs were of identical manufacture and model. The total cost of $23,168.69 for operation of Rig A may be broken down as follows:

1. Five major engines overhauls:
   - a $3,736.85
   - b $2,155.13
   - c $2,425.97
   - d $1,829.95
   - e $2,407.54

   Total $12,555.44 —54.25 percent
2. Parts and repairs over $100.00 (except above):

   Total $7,802.43 —33.20 percent
3. Miscellaneous parts and repairs under $100.00:

   Total $2,910.82 —12.55 percent

In contrast, the five engines on Rig B had but one major engine overhaul.

The practice of preventive maintenance is not the entire story in keeping such costs at their minimum. Of great importance is the equal loading and proper synchronization of the engines. The overloading of engines is a major cause of excessive engine cost. Engines running on natural gas, for instance, should not be pulled down below 5 inches of vacuum for hoisting and 3 inches of vacuum for driving the pumps, and comparable usage for diesel engines.

So far, only the above indicated 22 divisions of rig expense have been covered. Beyond these are:

- Moving in and out and rigging and related trucking, crane and A-frame work.
- Actual drilling progress (includes bits and drill string beads).
- Fishing tools and services.
- Fuel expense—especially on diesel rigs.
- Labor and supervision: the alertness, experience, skill and sound

TABLE 3
Potential Annual Savings From Wireline Alone on Ten Rigs

RIG	Drawworks HP	Wire Line Size	Actual Ton-Mileage	Attainable Ton-Mileage	Potential Annual Savings
(A)	900	1¼-inch	8.01	12	$2625.00
(B)	900	1¼-inch	7.91	12	2130.00
(C)	1300	1¼-inch	8.50	12	1785.00
(D)	900	1¼-inch	7.99	12	1634.00
(E)	*1500	1⅛-inch	6.84	10	1813.00
(F)	600	1⅛-inch	4.82	10	1760.00
(G)	900	1⅛-inch	5.89	10	2160.00
(H)	600	1⅛-inch	5.50	10	1605.00
(I)	600	1⅛-inch	5.00	10	1750.00
(J)	1000	1¼-inch	7.95	12	2084.00

thinking of every member of the entire organization.

These five categories are prolific sources of cutting costs and adding to profits. An individual with a practiced eye can walk around a drilling rig or a rig moving in and rigging up and see many opportunities to cut costs.

For example; are mud pumps, driven from the rig compound, spotted in a matter of minutes or does it take an hour or so? The crews under pressure to get rigged up frequently hear the expression, "that's good enough." This extra time may cost an extra $50 every move, with as much lost in decreased life of the V-belt drive. Here alignment brackets and ram screws (Figure 2-A & B) can be provided. When the pump is lowered into position it can be aligned mechanically in a matter of minutes. $100 spent now may return $100 on every move.

When moving, how much time is taken to handle and transport the many drums of lubricating oil required on a rig? Here $500 spent for a compartmented tank of suitable capacity to hold all required lubricating oils will make but one package to move. (Figure 3) This also elminates drum deposit charges. Each compartment, properly labeled, guards against mistakes in the use of the oil and keeps it free from dirt and contamination.

As pointed out earlier, the use of longer drilling lines to cut unit costs means that a line may last through the drilling of several holes. Contractors having wide box type sub-structures, with dimensions in the order of seven feet by six inches in width, might consider mounting the wire line reel in the box structure. The mounting may cost $50 or less, but it eliminates one more package to be handled as the reel will be moved with the sub-structure. These reels were designed only for delivery of the line to the rig and not for the abuse of handling and transporting many times. An endless rope, operated from the cathead, tacking on a small 2½-inch wide channel nailed to one flange of the wooden reel will allow the drilling line to be spooled on the reel rapidly and easily as soon as the mast is laid down.

On drawworks equipped with sand reels it is common practice to reeve the sandline first then to pull the drilling line through. A slot should be provided with a hinged door in the guarding behind the main drum so that the sandline can travel horizontally over the main drum spool for this operation. This eliminates pulling the sandline around sharp or abrupt corners which might damage the sandline.

A little thought given to proper work scheduling will pay off. Recently, a mud pump had to be replaced while drilling was in progress and the new pump had to be transported some 150 miles. The crane was on the job five hours waiting for the arrival of the new pump. A few minutes spent in establishing liaison by phone between the truck driver and crane operator would have saved the contractor approximately $100.

Drilling progress can be improved by utilizing new improvements in bit design, the use of heavier drill collars, the proper stabilization of drill collars for straight hole and minimizing the tendency to key-seat, and better mud control.

The contractor should avail himself of the various services such as having the joints on drill collars, and subs checked and magnafluxed at frequent intervals. API stress relief features for the joints on drill collars and subs have gone a long way in reducing pin failures. Use controlled torque indicators for make-up of joints, especially on newly cut joints. In other words, eliminate or minimize chances of having a fishing job right on the derrick floor.

Records on fuel consumption on diesel rigs show that the cost of fuel varies considerably per engine hp on engines doing the same type of work in the same area. This cost differential may amount up to as much as $25 per day on a 1200 hp rig. When specifying new engines see that this $25 goes into the contractor's pocket.

Under labor and supervision things happen which one might say can't happen as a sub with the wrong joint being run in the hole. It had to go through several hands, the yardman, the pusher and the driller, and even the stand-off of the treads before make-up went unnoticed. This did happen and it cost the contractor a $30,000 fishing job. A milled slot in the sub with appropriate markings will not only identify that sub against loss but will properly identify the type and size of joint at either end.

A string of drill pipe could be ruined by using the wrong size of slips day after day. This has happened twice within the last year in California. Two strings of 5-inch O.D. drill pipe were ruined by using 4½-inch slips. What contractor can afford to lose the greater part of a $75,000 to $90,000 investment?

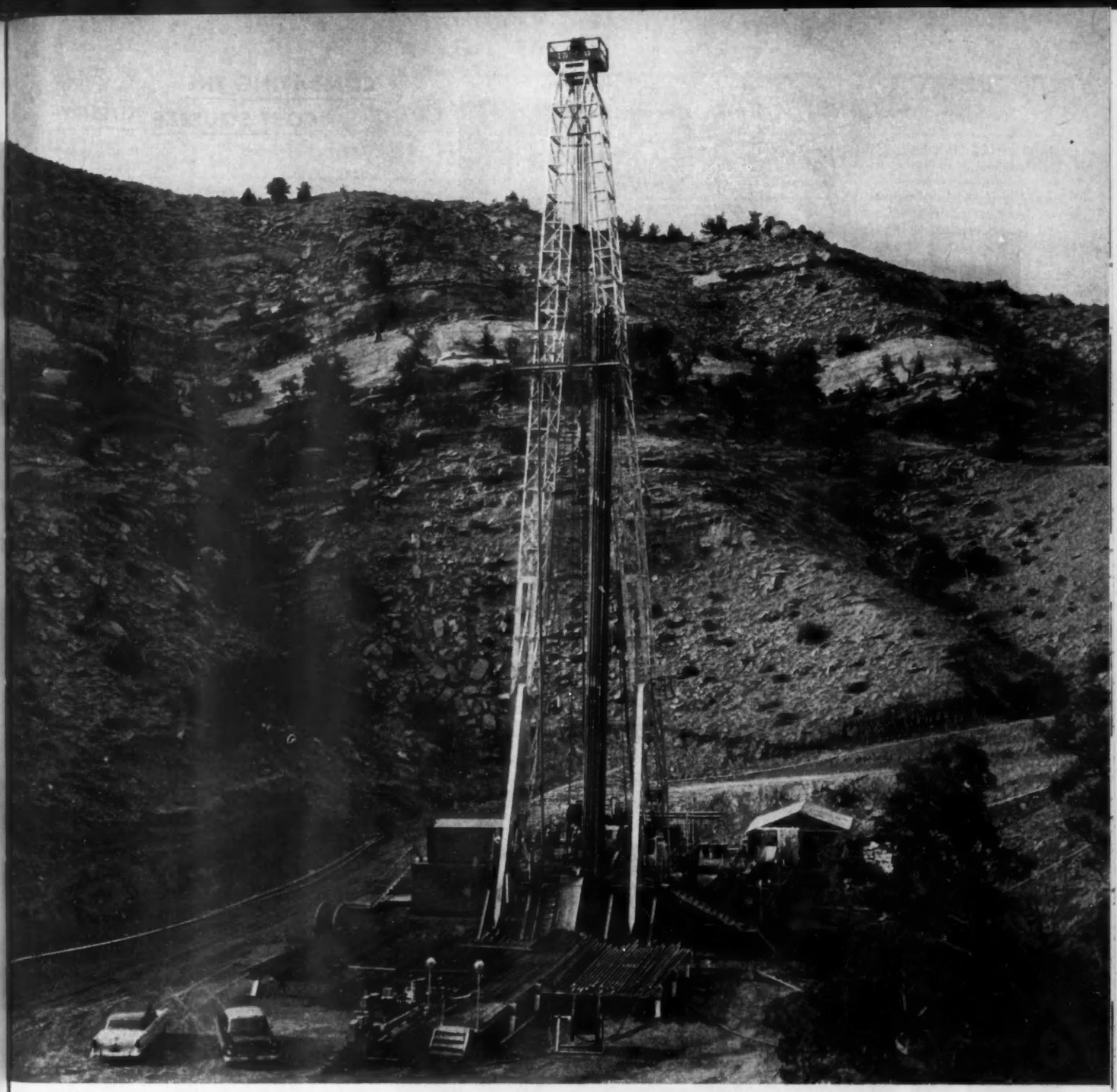
Contracting like many other pursuits is a legitimate business and entitled to a justifiable profit. Contractors are currently drilling over 90 percent of the holes drilled. The profits of contractors should be such as to allow adequate depreciation and amortization of their equipment so that replacements can be made when the economics or operation so dictate. Until footage prices reflect such an improvement, the contractor to survive must do everything possible to reduce his operational, drilling and maintenance of equipment costs.

—The End

About the Author

DAN DUNCAN has had 35 years experience as driller, field engineering with drilling contractors in designing of drilling equipment and consultant on off-shore drilling barges and installations. More recently, he established a consulting engineering service in Los Angeles designed to assist contractors in reducing operational, drilling and equipment maintenance costs. He is a California registered professional mechanical engineer.

How to keep your air compressor operating ▸



WIRE ROPE AT WORK

The scenic country near Grass Creek, Wyoming, was the setting for this drilling job, which had progressed to a depth of approximately 4500 ft when the photograph was taken. The hole at that time was approaching the Morrison formation. The crew expected to go down another 2000 ft before completing the well.

Owned by the Gist Drilling Company, Casper, the beautiful rig was as neat as a shiny new kitchen. Gist is well known for the excellent condition of his equipment, and his policy of careful maintenance has meant substantial operating economies. He has found another source of economy in the use of Bethlehem rotary line, which is unusually strong, tough, and long-lasting. On the rig shown here, 1¼-in. Bethlehem Purple Strand has proved a reliable workhorse, always equal to any demands imposed upon it.

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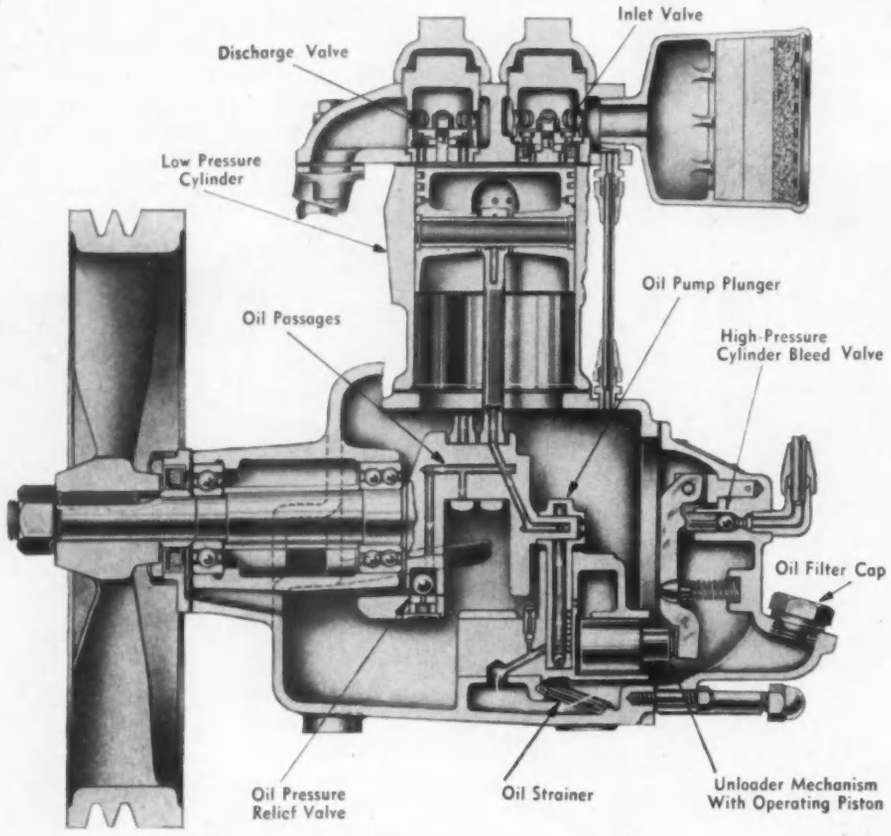
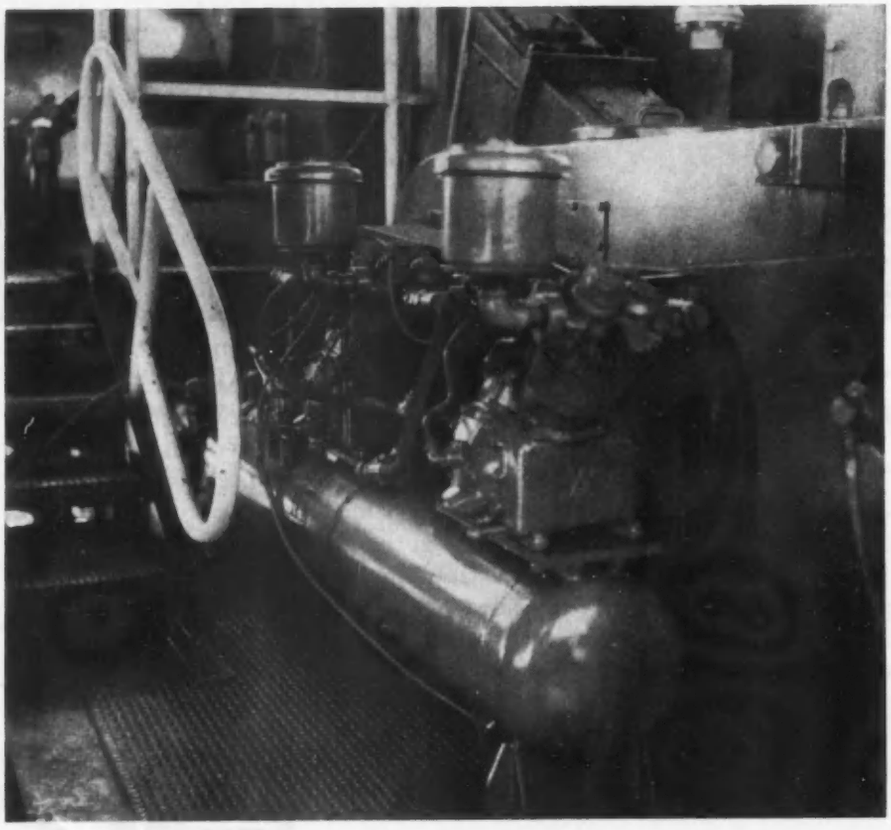


Cutaway view of a compressor portion commonly used on rigs for the air control systems.

COMBATING THE COST SQUEEZE

Diagnose Compressor Ailments Quickly

Downtime of compressor units can be reduced by these easy-to-follow maintenance rules.



Rig-mounted compressors connected with drawworks.

By E. D. Couch
Le Roi Division
Westinghouse Air Brake Co.
Milwaukee, Wis.

THE HEART of every pneumatic system is the air compressor. It compresses air which can be delivered and stored in a relatively small space from where it may be transmitted to local or remote stations to provide the force to control or enforce movement.

In order to give good and economical service, air compressors must operate as near trouble-free as possible. Like all pieces of equipment, the air compressor is subject to breakdowns and adverse operating conditions.

In order to help the operator "stay in business" with a minimum of effort and expense, these basic rules for maintenance of good compressor service are submitted.

See next two pages

SYMPTOM	POSSIBLE CAUSE	CURE
Air gage shows too low an air pressure in tank	Defective air gage	Replace air gage.
	Pressure switch	Check setting and if incorrect reset. (See instructions on pressure switch.)
	Air leaks in line	Eliminates all leaks in air lines and in unit.
	Low oil pressure	See that oil level in the crankcase is at the proper height. Clean the oil inlet to the oil pump in the crankcase.
Air gage shows too high an air pressure in tank	Defective air gage	Replace.
	Pressure switch	Check setting. If incorrect, reset. (See instructions for pressure switch.) Check for sticking contact or partial binding within switch. Do not take all tension off control springs.
Continuous flow of air thru relief valve on pressure switch	Leaking check valve in discharge pipe	Clean check valve.
Compressor will not unload	Improper adjustment of relief valve on side of pressure switch	Adjust valve trip lever.
Air tank pressure builds up too slowly	Clogged intake filter	Clean filter. See maintenance instructions.
	Valves	Remove any dirt or carbon on valve or seats. Eliminate any air leakage past copper gaskets under valve. Tighten valve plugs if found to be loose. Replace warped, cracked or broken valves.
	Belts slipping	Check belts for tightness —tighten if too loose.
	Leakage in unit	Test tank and all connections and fittings on it for air leaks.
	Air load too great for compressore capacity	Calculate air requirements of devices used with compressor. If these are more than three times capacity of compressor, replace compressor unit with a larger one.
Compressor overheats	Single staging.	Examine high pressure inlet and discharge valves for leakage. Replace broken or worn parts.
	Excessive discharge pressure	Check pressure switch. Repair or reset as required.
Excessive belt wear. Always replace belts in sets	Misalignment	Realign unit.
	Belt too tight	Adjust tension.
	Belt slipping	Adjust tension.
	Pulley wobble	Determine causes of wobble and correct.

SYMPTOM	POSSIBLE CAUSE	CURE
	Flywheel loose	Tighten nut which holds flywheel in place on shaft.
	Valves	Remove foreign matter that may be trapped. Tighten valve plugs between piston and cylinder head.
	Motor pulley loose	Tighten motor pulley.
	Loose connecting rod	Tighten connecting rod from .0015″ to .003″ clearance.
	Bent connecting rod.	Replace.
	Oil pump	Oil pump having plunger fitted too tightly in its cylinder should be replaced.
	Ball bearing	Replace bearing.
Knocking	Motor	Where knock is caused by excessive armature end play it may be eliminated by realignment of motor to compressor. If this does not stop knocking, report trouble to nearest office of motor manufacturer.
	Wrist pin	Replace.
	Piston hitting head or valves	If piston hits valves, but not head, place extra gaskets under valves to eliminate interference. If piston hits head add extra cylinder gaskets between cylinder and crankcase.
	Hydraulic knock in oil system	Drain all oil from compressor and run for short period of time. If knock disappears it is a hydraulic knock and is not injurious to compressor.
Rapid knocking in motor	Misalignment causing shoulder of shaft to pound against bearing end	Realign unit.
Oil thrown from flywheel end of crankshaft	Oil seal leakage	Clean breather line. Replace oil seal. If worn replace sleeve for oil seal.
Safety valve blows	Dirt under valve	Clean and reset.
	Incorrect setting	Reset.
	Incorrect pressure switch setting or defective pressure switch	Check pressure switch, or reset as required.
	Broken spring in safety valve	Replace and reset valve to maximum working pressure stamped on tank.

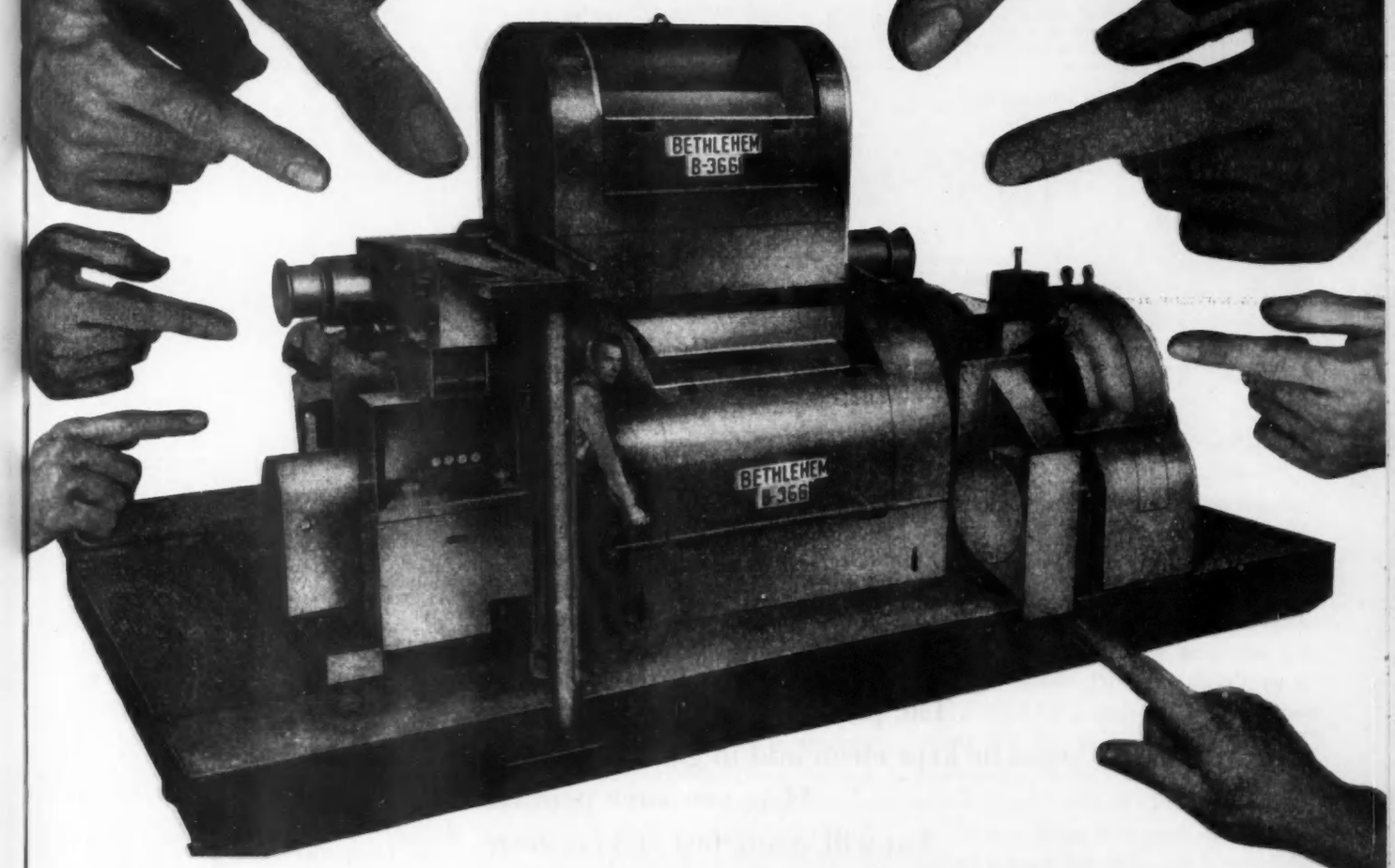
Keep going for more compressor operating hints ▸

SYMPTOM	POSSIBLE CAUSE	CURE
Overload heater trips	Low voltage	Obtain proper voltage. Voltage drop should not be more than 5%.
	Incorrect pressure switch setting	Where the normal pressure for the unit has been raised, reset the pressure switch.
	Mechanical trouble in compressor	Locate and make necessary repairs.
	Wrong voltage	Obtain correct voltage or correct heaters.
Motor overheats. Check with thermometer—DO NOT USE HAND—140 °F. max. allowable temperature	Low voltage	Obtain proper voltage. Check size of wire from service lines to compressor unit. If too small replace with proper size. Voltage drop should not exceed 5%.
	Wrong voltage	Check line voltage and see that motor is properly connected for that voltage.
	Worn bearing	Replace motor or consult motor manufacturer.
	Defective starting switch in motor	Replace motor or consult motor manufacturer.
	Belts too tight	Adjust to proper tension.
	Mechanical trouble in compressor	Locate and correct.
	Too frequent starting	Check air load on compressor unit against its capacity. If greater than 3 to 1 replace with larger unit. Increase range between cut in and cut out settings of pressure switch.
	Dirt in motor	Check flow of ventilating air and blow out motor.
	Rotor rubbing on stator	Replace motor or consult motor manufacturer.
	Shorted stator winding	Replace motor or consult motor manufacturer.
	Motor grounded	Replace motor or consult motor manufacturer.
Motor bearings overheating	Misalignment	Realign unit.
	Belts too tight	Adjust belts to proper tension.
	Excessive end thrust	If motor is off level, shim up lower end to take thrust off its bearing.
	Too much grease (ball or roller bearings)	Relieve supply to point set by manufacturer.
	Lack of lubrication	Lubricate as specified by motor manufacturer.
	Sticking oil ring (sleeve bearing)	Clean, repair or replace as as necessary.

SYMPTOM	POSSIBLE CAUSE	CURE
Motor will not run	Blown fuses	Replace with fuses of correct capacity.
	Broken lead wires	Check leads for continuity.
	Defective pressure switch	Repair or replace. Check for worn contacts and replace all contacts if one must be replaced.
	Tripped overload heater	Reset heater and locate cause of trouble.
	Defective starting switch in motor	Replace motor or consult motor manufacturer.
	Defective condenser on capacitor start motor	Replace motor or consult motor manufacturer.
	Single phasing of polyphase motors at starting	Check source of power and wiring.
	Load too heavy	Check for possible binding in compressor.
Reverse rotation of compressor	Improper connections	If polyphase motor, interchange two leads. If capacitor motor, check connections and change for proper rotation. If single phase repulsion induction motor, adjust brush yoke for proper rotation. (This applies to older type motor only.)
Water in cylinder heads or in oil	Compressor runs for too short a period of time	Change cut in point of pressure switch so that once compressor is started it will run for at least 3 minutes.
Hot unloader pipe	Low oil in crankcase	Fill crankcase to proper level.
	Unloader valve leakage	Clean unloader valve in end cover.
	Defective oil pump	Clean and repair or replace oil pump.
	Leaking crankshaft relief valve	Clean relief valve and seat.
Intercooler safety valve blowing	Broken spring	Repair and reset valve.
	Safety valve set too low	Reset safety valve to open at 60 lbs. psi.
	Leaking high pressure cylinder head valves	Clean and repair valves in high pressure head as required.
Excessive oil passing	Broken rings	Replace.
	Badly worn rings, pistons and cylinders	Replace.

HERE'S THE BIG ONE...

for the deepest holes ever drilled



Here you have it — the Bethlehem B-3661 drawworks — a drawworks big enough and strong enough for faster, more economical drilling of those deep, deep holes. It's a product representing years of engineering study and development work. The first in its class is now ready for use.

This huge drawworks is capable of drilling to any depths required now or in the foreseeable future. It is by long odds the largest outfit Bethlehem has ever built — largest in shaft size, drum dimensions (36-in. diam x 61½ in. long), brake flanges (64-in. diam), chains, bearings, clutches. Look at the photograph. The man, who is over six ft tall, provides a good comparison.

The B-3661 has all the reserve power ever needed to meet any emergency. It is offered with four speeds for electric-motor application, four speeds and reverse for torque-converters, and six speeds and reverse for conventional mechanical drive. Suitable compounds for three and four engines can be furnished, these being available with two-speed pump-drive transmissions at nominal extra cost.

Three input drive positions are possible, making the unit highly flexible with respect to the positioning of prime movers. In the case of electric-motor drive, two or three motors may be used, each with its own chain to the drawworks.

The B-3661 is making *news*. It is a pioneer in the field of bigger and better drawworks. For full details, call the nearest Bethlehem Supply office. The facts are worth having!

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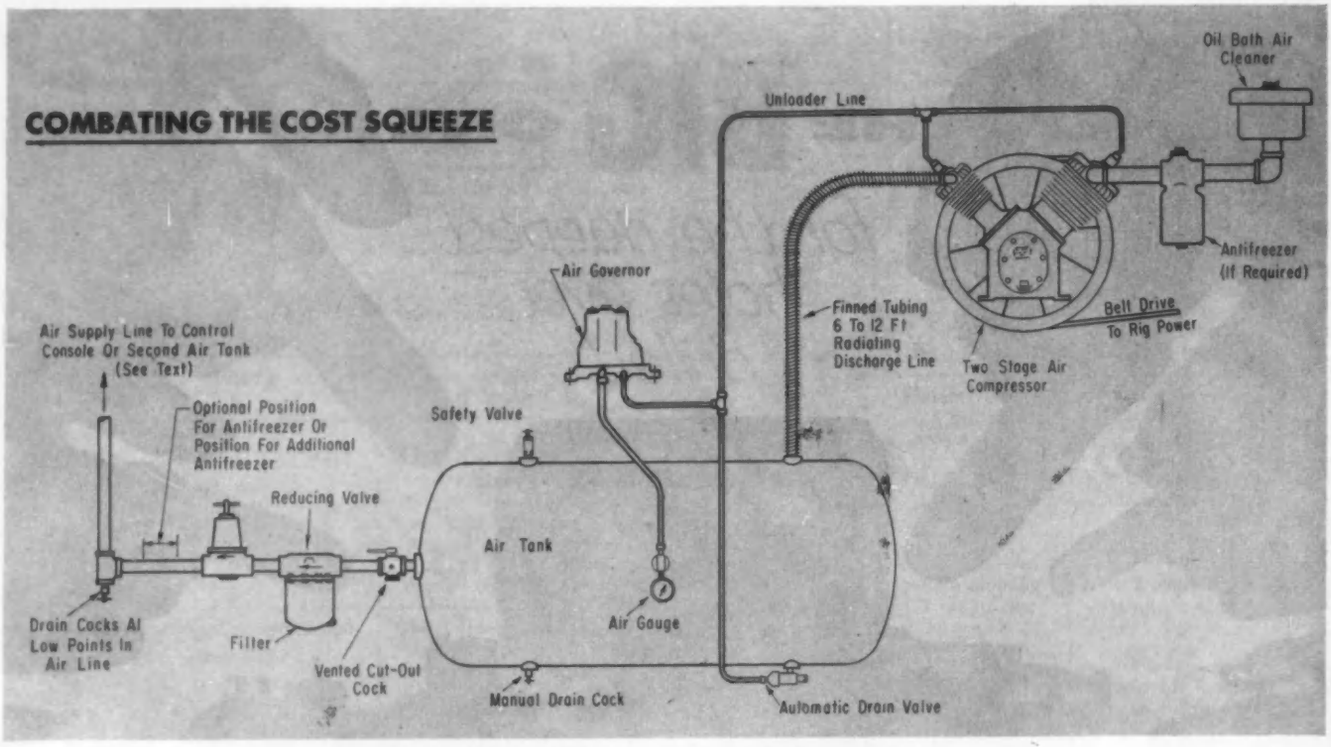
Oil Bath Air Cleaner
Unloader Line
Antifreezer (If Required)
Air Governor
Finned Tubing 6 To 12 Ft Radiating Discharge Line
Belt Drive To Rig Power
Two Stage Air Compressor
Air Supply Line To Control Console Or Second Air Tank (See Text)
Optional Position For Antifreezer Or Position For Additional Antifreezer
Safety Valve
Reducing Valve
Air Tank
Drain Cocks At Low Points In Air Line
Filter
Vented Cut-Out Cock
Air Gauge
Manual Drain Cock
Automatic Drain Valve

FIGURE 1—Recommended arrangement of air supply components.

How to Maintain Rig Air Control Systems

The pneumatic 'hands' of the rig must be kept clean and in good condition. Here are some pointers that will assure fast and accurate response to driller's touch.

By W. J. Taylor
Westinghouse Air Brake Co., Dallas

COMPRESSED AIR IS used to perform a multitude of functions on a modern oil well drilling rig. The pneumatic systems in use today range from the simple control of engine speed and clutches to complete systems for the interlocked control of drum clutches, transmission position, pump drives, brakes, catheads, compounds and power slips. The importance of the rig air control system far exceeds its cost. It is the means by which an investment of thousands of dollars in machinery is made to respond to the will of one person, the driller.

A good air control system must be fast, accurate and thoroughly dependable. The reliability of an air control system depends upon (1) good design and quality control by the component manufacturer, (2) careful layout and installation by the rig builder, and (3) proper care and maintenance in the field by the operating crews. It is the latter, field maintenance, upon which the long term usefulness of an air control system will largely depend. Like any piece of mechanical equipment with moving parts, the compressors, air valves and devices are susceptible to dirt, rust, lack of lubrication and mishandling. But with simple, regular maintenance, an air control system will give years of dependable service. This article will point out general maintenance procedures for air systems and make specific recommendations. A section on trouble shooting an air system is included.

A simple air control system may be divided into three major sections, (1) the air supply with accessories, (2) control valves and devices, and (3) actuators and power devices. The more elaborate systems are just multiplications of the simple system with one air supply serving the entire assembly of devices.

The Air Supply. The air supply section consists of the air compressor, filters, air storage tank, governor, safety valve, cooling pipe, drain valves, reducing valves and the piping to the control console.

The air compressor is nearly always

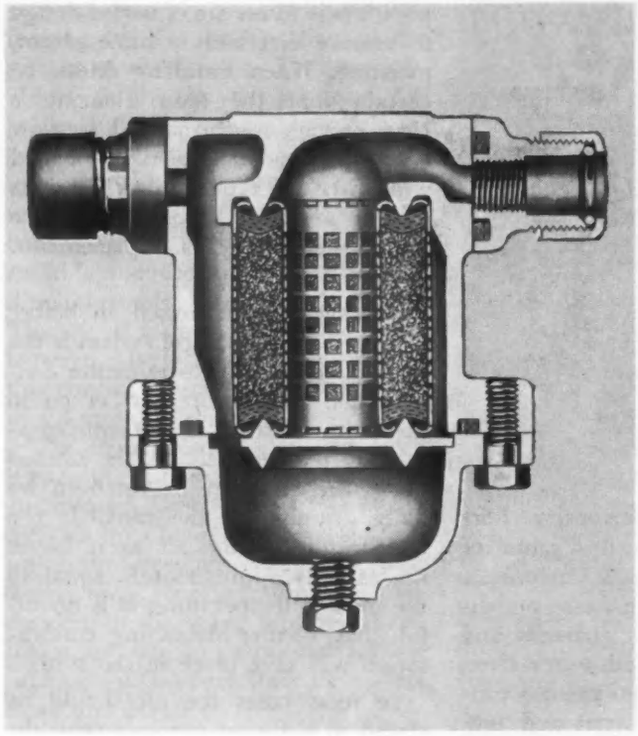

FIGURE 2—Typical air line filter with large replaceable element.

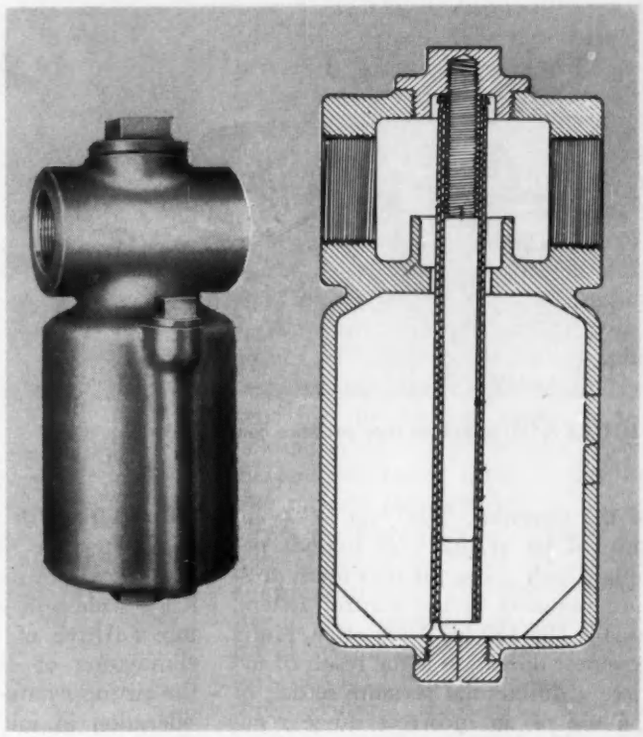

FIGURE 3—Antifreezers used in suction of compressor.

of the two stage type and is driven off the compound or connected by belts to a drilling engine. Proper alignment and belt tension should be maintained and belts must be replaced with a matched set when worn. Proper rotation of the compressor should be checked, the integral fan blades of the flywheel must direct cooling air over the compressor portion. Correct rotation is usually indicated by an arrow cast on the flywheel rim. Adequate air flow for the compressor intercooler and finned heads must be maintained. This flow of cooling air should not be obstructed by heat generating devices such as radiators, or other large pieces of equipment. Any efforts to cool the compressed air during compression and storage will be rewarded by better performance and longer equipment life.

The oil level in the compressor crankcase should be observed weekly and sufficient oil added to maintain the recommended level. In most cases, use a high grade automobile engine oil but follow the compressor manufacturer's recommendations.

Improper grade or low quality oil will result in excessive carbonization of the cylinders and valve elements. A complete change of oil should be made at least every three months. More often than this if inspection indicates the necessity.

A great many oil rig compressors have a low oil pressure interlock feature which prevents operation at low oil levels and provides starting unloading. Failure of the compressor to pump air will result from sediment or sludge in the crankcase causing a restriction at the oil pump strainer, sticking of the unloader piston or leakage at the ball check unloader valve. In this case, dismantle and thoroughly clean the crankcase, cover, unloader mechanism and oil pump. Be certain that oil pressure relief valve, spring and passages, usually located in the crankshaft counter weight, are clean and seating properly.

The valve caps on the cylinder heads should be removed periodically and the inlet and discharge valves and their seats thoroughly cleaned. Reassemble carefully, being certain to replace the valves in the correct ports and in the proper position. Complete overhaul of a compressor should be attempted only in a properly equipped shop by trained personnel. It is wise to have the compressor overhauled when it shows evidence of pumping large quantities of oil past the piston rings because this highly carbonized oil will foul the control valves.

The oil bath air cleaner on the intake port of the compressor should be checked regularly for proper level and cleanliness. The discharge line from the compressor to the air tank should be equal to the port size on the compressor. This line should be 6 to 12 feet in length and sloped towards the air tank for drainage of condensate. Since finned tubing is about three times as effective a head radiator as plain iron pipe, the use of finned tubing for this line is strongly recommended.

The air tank must have at least one drain connection at the lowest point. This connection may be equipped with an automatic drain valve or if manual, must be drained daily to remove condensation and dirt from the bottom of the tank.

The air governor is a device which determines the tank air pressure at which the compressor loads and unloads. It must always be connected directly to the air tank and never to the discharge line from the compressor. Observation of compressor operation with reference to an air gage connected to the air tank will detect the "cut in" and "cut out" pressures

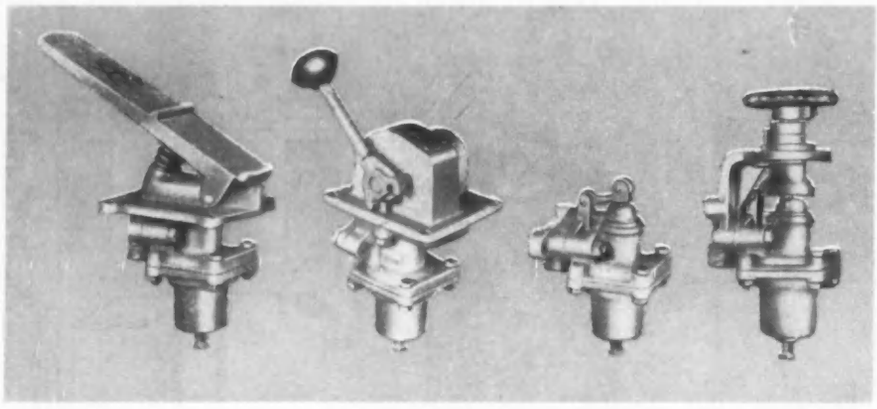

FIGURE 4—Diaphragm type pressure control valves.

of the governor. The "cut in" point should be at least 20 pounds per square inch above the maximum pressure required in the control system, usually 125-150 psi. Very often, faulty governor operation is the result of too close a differential pressure setting or the use of an incorrect range regulating spring. The minimum differential between the "cut in" and "cut out" pressures should be about 15 psi. Most governors cannot drastically change their operating range without changing regulating springs. Consult the manufacturer's literature for correct parts and ranges. This device is relatively trouble free when operating in a system with clean air but the valve seats are critical. The cleaning and repair of the unit should be attempted only indoors in a dust free atmosphere and the seats should be lapped with a fine jewelers rouge or rubbing compound. No coarse valve grinding compound should be used. A light oil is used for lubrication. A short blow of air from this device when "cut in" and "cut out" pressures are reached is not an indication of faulty operation unless the blow lasts for an extended period of time.

The lines leading from the air tank to the control console should be slanted to drain back into the tank or toward a point where a drain valve may be installed. All low points in the air line should be equipped with drain cocks to permit removal of accumulated sludge and moisture. Supply lines should be ½-inch pipe or larger depending on the size of the system. Very often, the addition of a small air tank at the control console will prevent excessive pressure drop during momentary high air demand. The air lines in a system should be blown out weekly to remove accumulated dirt.

Clean, Dry Air a Necessity. Dirt and water are the greatest cause of malfunction in pneumatic equipment. Rust, scale and sludge cause premature failure of many elements and elimination of dirt and water from the air supply must be of primary consideration in initial layout and preventive maintenance. A line diagram of an efficient air supply system is shown in Figure 1.

The intake filter on the air compressor should be supplemented by an inlying filter downstream from the air tank. Frequently, additional filters are placed in the control console and downstream from points where the air lines are frequently taken apart, such as between the skids on rigs which are sectionalized for transport. These filters are of varied design to remove dirt and to some extent, moisture. When installing filters, be certain that the filter element is large enough to permit full air flow even after becoming partially clogged with dirt. The type of filter elements used is a matter of personal choice and availability of replacements. (Figure 2).

Cooling the compressed air before it is used in the control system is the most effective way to minimize condensation of moisture further on in the system. Most of the condensation then takes place in the storage tank where it can be removed by daily draining of the tank. If the temperature of the air as it leaves the tank is approximately equal to the outside temperature, it is doubtful that further damaging condensation will take place in the system.

In most cases the air should be stored at a higher pressure than the maximum required by the control system and reduced to a usable pressure by a pressure regulator. It is advantageous, capacity-wise, to utilize the air at the lowest pressure which will effectively perform the work. Compression and subsequent cooling causes considerable moisture to be removed from the air. But this air is still saturated with water vapor. A reduction in pressure, at a relatively constant temperature will re-

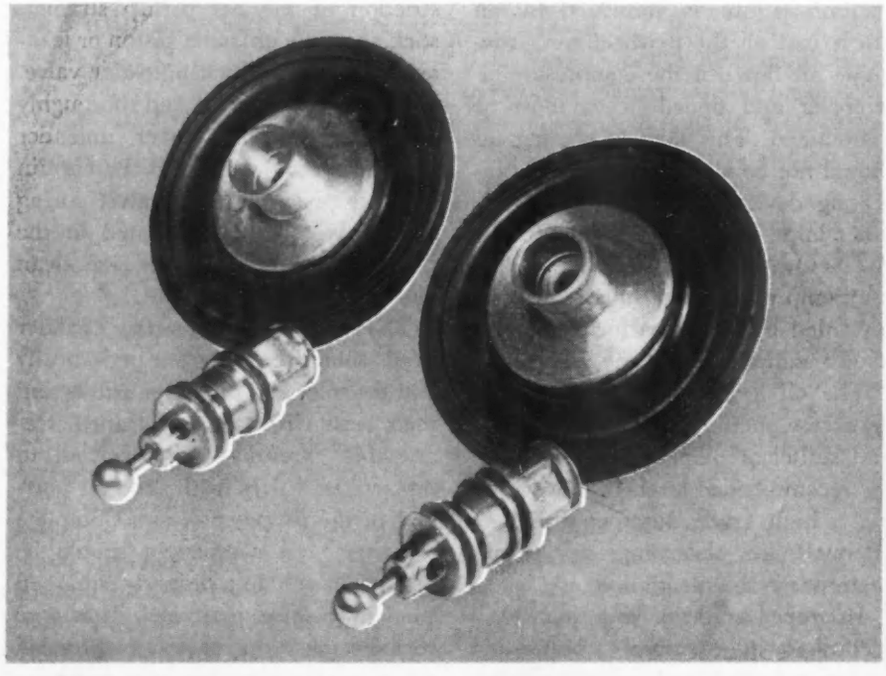

FIGURE 5—New and worn valves and seats for diaphragm type pressure control valve. Worn parts are shown in foreground.

sult in drop in relative humidity, making further condensation in the system more difficult. For example, reduction of saturated air from 200 psi to 100 psi, without changing its temperature, reduced the relative humidity from 100 per cent to approximately 53 per cent. If this air was being stored at 90° F. its temperature could be reduced to 70° F. before additional condensation takes place. The use of a pressure reducing valve between a high air tank pressure and the control system is recommended to aid moisture control.

The elimination of dirt and moisture in the air supply cannot be overemphasized. Cost analysis figures are difficult to obtain but several drilling contractors in south and west Texas have reported substantial reduction in air valve repair and replacement due to simple but regular attention in keeping their air system clean and dry.

Freezing Condition. Where freezing conditions are encountered the presence of moisture in the air is even more serious. It is impractical on a drilling rig to take steps to obtain extremely dry air, that is, air dry enough so that extremely low outside temperatures will not cause freezing of the water vapor. Other means must be taken to prevent damage due to freezing. The most common method used in the oil field is the installation of an antifreezer in the air system. This device is a small reservoir containing alcohol with some method of feeding alcohol vapor slowly into the air stream. Antifreezers, such as shown in Figure 3, are used in the suction of the compressor or in the air supply line between the tank and the control console. The suction antifreezer provides the most complete protection for the entire system, including the compressor and tanks. Under extreme conditions a second antifreezer should be installed near the control console to be certain that alcohol protection reaches the final apparatus through the maze of piping bends and fittings. Methyl alcohol solutions only should be used in the antifreezer. Install a vented cut out cock upstream from an antifreezer when installed in a pressure line so that the line can be vented while replenishing the alcohol. The use of antifreezers should not preclude the steps mentioned before for moisture control. In fact, these steps become more important under freezing conditions.

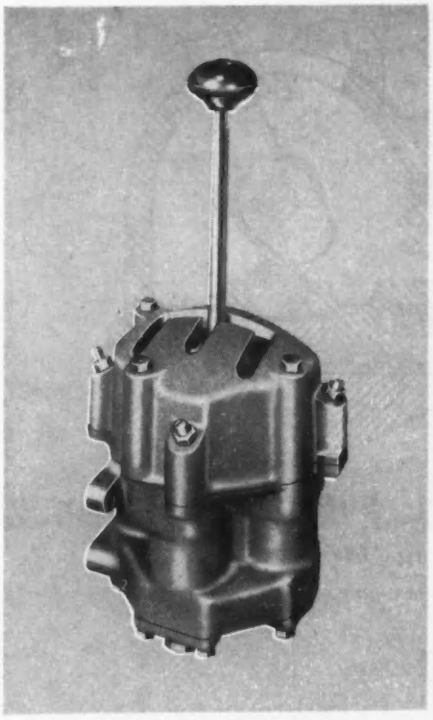

FIGURE 6—Piston type multiple pressure control valve.

Control Valves and Devices. There are two basic types of control valves, (1) pressure controls, and (2) line controls.

Pressure control valves have a delivery pressure which is directly proportional to the amount of handle movement, (foot pedals and hand wheels are also used). They are used for throttle control and clutches where control during engagement is desired.

Line control valves are either full open or full closed. When open, they deliver full line pressure at the delivery ports. They are used for clutches and other operations where pressure control is not required.

Pressure Control Valves. The diaphragm type pressure control valve shown in Figure 4 is the most widely used. These come in single and double types, and some contain one or two additional line control valves for selecting various clutch combinations.

These valves should be dismantled periodically for inspection, cleaning and lubrication. Wash all metal parts in a suitable solvent such as kerosine or one of like characteristics, wash all rubber parts with soap and water and dry with a low pressure air jet. Replace worn or defective parts with new ones. Check the diaphragm carefully for cracks, broken sealing beads and other defects. The pipe bracket strainer and seals should be clean and undamaged. Examine rubber "O" rings for cracks and signs of wear. Pay particular attention to wear on valve seats as shown in Figure 5. Wide bands on ball seats or grooves in the ball valves are signs of wear and a potential source of high leakage. During reassembly, all friction surfaces and rubber packing rings should be lubricated with a light, wide temperature range grease except for the friction brake in self holding handle type valves. Heavy air line lubrication tends to foul up the intricate passages and valve elements in these units so line lubrication of this type of valve is not recommended. The handle yoke should be assembled to give short travel control range from 10 to 60 psi when used with 60 psi springs for throttle control (see Section "Throttle Control"), and reversed for long handle travel to provide full range control for clutch or braking operation with all springs. The friction brake on self holding handle type valves should be tightened when necessary to prevent handle creep due to vibration.

An additional one or two line control valve portions for clutch control will be found in some of these valves. The same maintenance instructions apply, but adjustment of this type of valve on reassembly is more difficult. Be certain that end play is completely removed from the cam shaft when reassembling. Any end play will prevent accurate adjustment of the valve levers. It should be attempted only by experienced personnel. To adjust the small internal lever which operates the selector valves, move the handle of the valve to applied position, turn the adjusting screw in the end of the lever out very slowly until delivery pressure in the appropriate delivery line starts to drop (as indicated on an air gage). Then turn the adjusting screw in for one and one half turns. Test for capacity and make minor adjustments. A small volume (12 inch capped length of 3 inch pipe) is useful as an indication of the ability of the valve to supply air. A slow build up of pressure in the small volume would indicate a restricted passage or faulty valve adjustment. Be certain that the release capacity is sufficient to cause

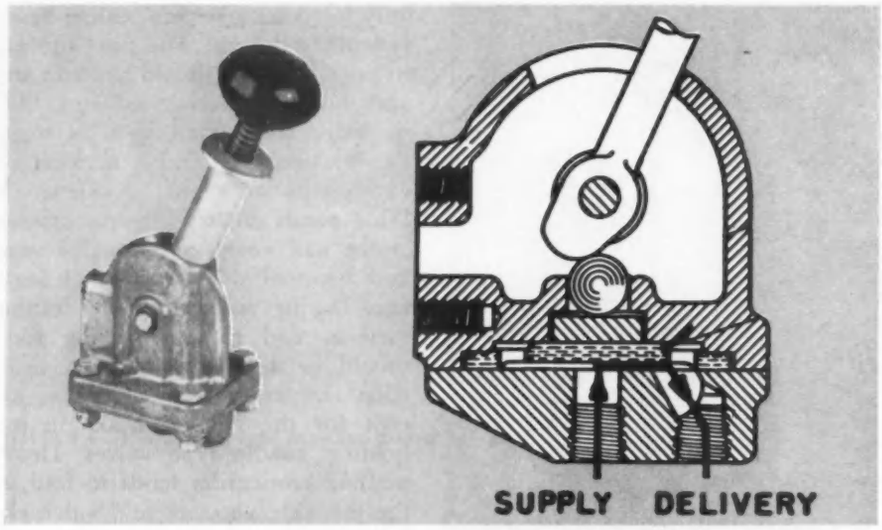

FIGURE 7—Diaphragm type line control valve.

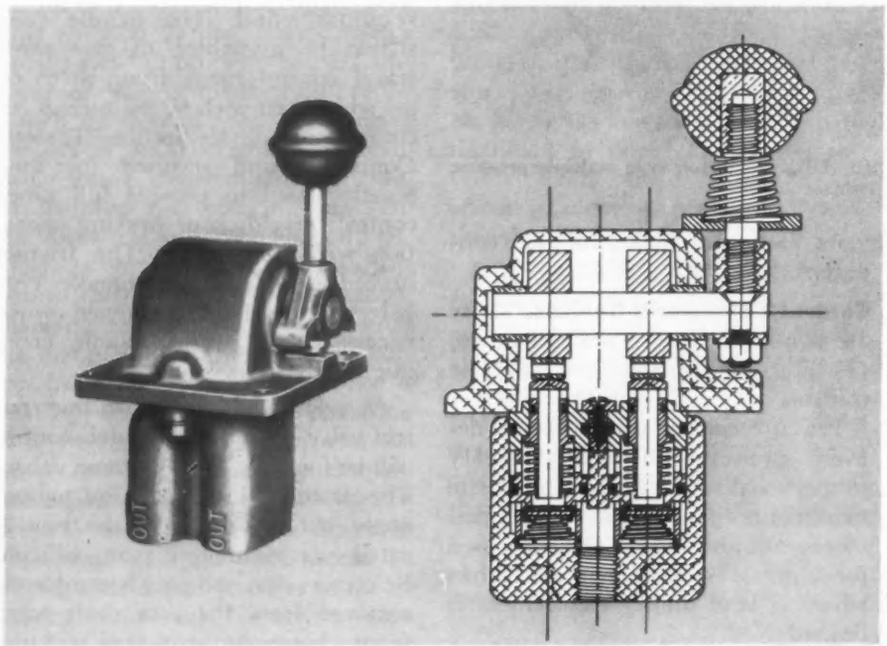

FIGURE 8—Poppet type line control valve.

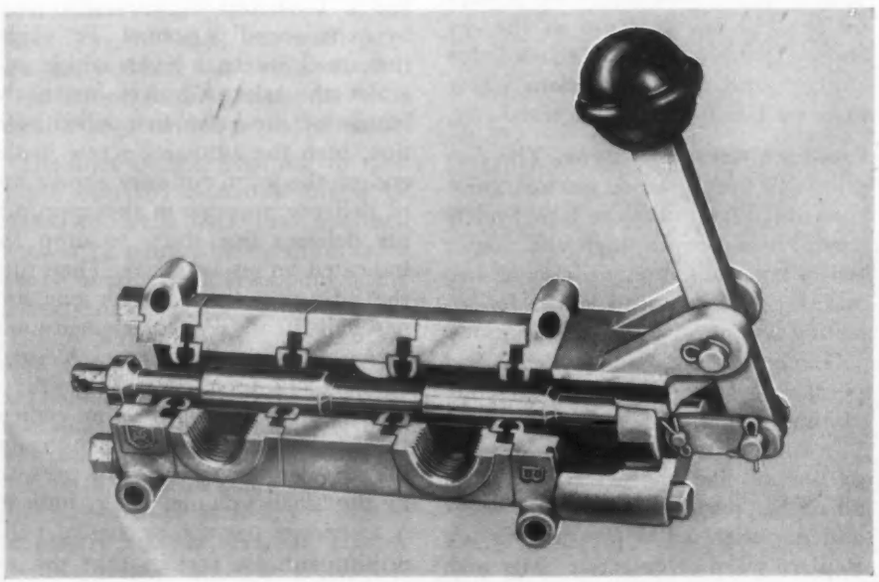

FIGURE 9—Spool type line control valve.

a quick release valve to operate. This test can also be used with line control valves.

This adjusting screw at the extreme bottom of the spring housing should not be used except for setting throttle preload (see Section "Throttle Control"). Many times this screw is mistakenly adjusted to eliminate a blow of air from the bottom of the housing when the valve is in neutral. This incorrect adjustment does not stop the leak and may cause light air pressure to be maintained in the delivery line in neutral causing damage to an air clutch.

Piston type pressure control valves as shown in Figure 6 are used in many cases for multiple operations. Basically, the same maintenance procedure as applied to the diaphragm type, also applies to this valve. On disassembly the piston may be pulled from underneath the valve, but to avoid damage to the packing cup, a thin strip of metal (similar to a feeler gage) must be used to cover the port in the cylinder wall while the packing cup passes the port. A rod with a notched end can be inserted in the seat port to pull the piston, inspect the valves and seats. Pay particular attention to the fit of the handle pivot ball and the condition of the cam surface and rocker arm rollers. Flat and worn spots will cause erratic valve operation. A medium consistency graphite grease is recommended for all sliding surfaces in this valve. A multi-function valve such as the four element valve, can have any combination of pressure control and "on and off" elements (indicated by substitution of a solid collar for the spring.) If the valve elements are not reassembled correctly in their respective valve body positions, serious trouble can result. The spring valves may differ in each element. If the clutch and throttle valve elements were mixed, the result would be low air pressure on the clutch and poor throttle control. Some of the elements may contain a small adjusting screw at the top of the piston assembly for obtaining full line pressure at maximum handle position. This should be carefully adjusted to give the desired operation. The external set screw on the cover is used to prevent the rocker arm roller from dropping under the handle cam and to set throttle preload (see "Throttle Control") and the internal rocker arm

set screw is used to make small adjustments in maximum delivery pressure. The balance between these two adjustments should receive careful checking before placing the valve in service.

Line Control Valves. There are many different types of "on and off" valves in use today on drilling rigs. Most of the care and maintenance procedures as apply to pressure control also apply to line controls. Exceptions and specific instructions are described below. Line controls are much simpler in construction than pressure controls.

A diaphragm type line control valve is shown in Figure 7 and consists of only one molded rubber sealing element. This should be cleaned and inspected periodically. The bearing surfaces of the ball handle and shaft become worn and loose and present the possibility of unintentional operation. They should be replaced when worn.

The poppet type line control valve shown in Figure 8 is very popular. It requires only periodic cleaning and replacement of the "O" rings and molded rubber supply valve. Do not force or hammer on the valve stem as this will damage the seat at the bottom of the stem. The bushing in the body is not replaceable in the field.

Spool type valves such as shown in Figure 9 are becoming more popular due to their simplicity, versatility and high air flow characteristics. In spool type valves, line lubrication with a light oil is desirable for long service, but not essential if the valve is periodically dismantled, cleaned and lubricated with a lime base grease. When reassembling the valve, place the stenciled end of the spool in the end of the valve with the name plate.

Quick release valves may contain a molded rubber actuating diaphragm or a piston with rings. The diaphragm type is used on small clutches and the larger piston type on large clutches. Both types should be cleaned periodically. In the piston type, the piston must move freely and without binding. A light grease lubrication is used. A diaphragm type quick release valve is shown in Figure 10. Quick release valves should be used on all air clutches and placed in the line as close to the clutch chamber as possible. This is usually just before the rotating shaft seal.

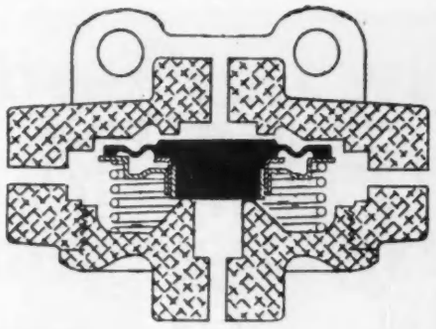

FIGURE 10—Diaphragm type quick release valve.

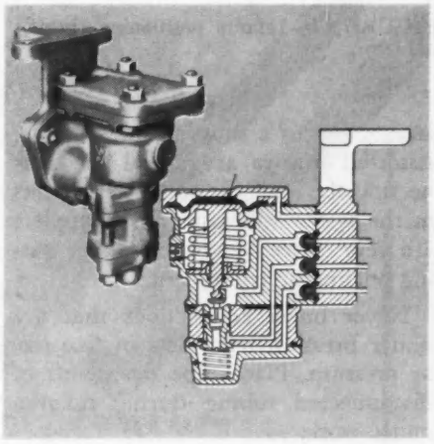

FIGURE 11—Relay type line control valve normally used in clutch interlock system.

Relay valves of various types are nothing more than diaphragm operated line control valves (see Figure 11). The most common arrangement is one placed in lines leading to the high and low drum which will prevent one clutch from being engaged until the other clutch air pressure has been completely released. These valves should be dismantled, cleaned and lubricated with a light grease periodically. These valves contain lapped brass seats and valves and repair should be attempted only in a clean shop by experienced personnel. The top of the valve body is stamped with the diaphragm pressure rating at which the valve will shift. Faulty operation can be detected if the valve elements do not shift at or near this control pressure.

Power Devices and Actuators. The most common oil field device used to change the energy stored in compressed air to some form of useful work is the air clutch. These come in many types, each for a specific application. Usually they consist of an air tight chamber, which when filled with compressed air will force friction elements together causing engagement between the driving and driven members of the clutch. Occasionally the air chamber in the clutch leaks and requires replacement. Follow the clutch manufacturer's instructions. Very often clutches are difficult to dismantle from the machinery and some operators place small "in-line" filters immediately upstream of the clutch to prevent entry of dirt and moisture.

A double acting air cylinder is shown in Figure 12. These are relatively trouble free devices requiring only occasional dismantling for cleaning and lubrication. Line lubrication with a light oil (SAE 10) is recommended for air cylinders. When this is not possible, it is recommended that all friction surfaces be periodically cleaned and lubricated with a wide temperature range or lime base grease. The seal on the piston packing cup can be checked by placing air pressure on one end of the cylinder, then dismantling the line on the opposite

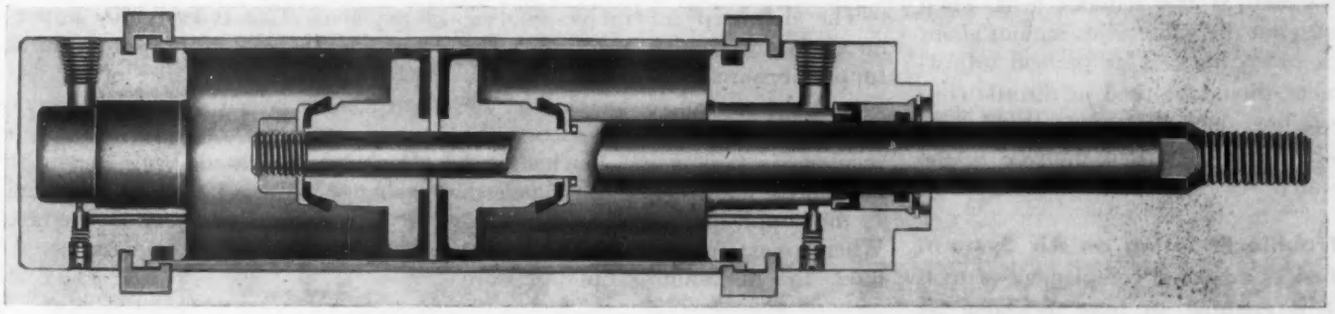

FIGURE 12—Clamp ring type double acting air cylinder with adjustable cushioning.

end and observe for leakage. Often, an air blow heard at the control valve exhaust port will be caused by cylinder cup leakage.

Infinite positioning actuators are used to control throttle position. An actuator is shown in Figure 13. The diaphragm is opposed by a very accurate spring and the unit has a nominal rod end travel of 2 inches. Dismantle periodically for cleaning and carefully inspect diaphragm for cracks, worn beads and flexibility. The grease fittings should receive regular attention with a pressure gun and any joints between the actuator and the throttle links should be kept lubricated to maintain low friction.

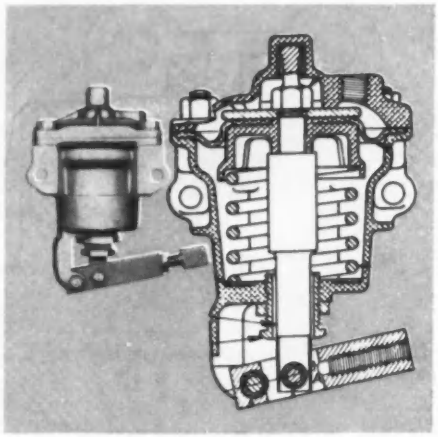

FIGURE 13—Infinite positioning throttle actuator.

Throttle Controls. Actuators and pressure control valves are used in sets for throttle control. As factory assembled, the actuator elements are so matched that lever travel starts at about 10 psi control pressure and attains maximum rod travel at about 60 psi control pressure. The length of the rod end stroke can be adjusted to match the operated device by use of the threaded rod. The arm maximum travel adjusting nut on the end of the housing and the arm length adjustment can be used to match two or more actuators, operating from one pressure control valve, to differing operating characteristics of the engines. In order that a sensitive throttle operation can be obtained, the pressure control valve used with an actuator should have a 10 psi preload in the delivery line. This adjustment is made on the diaphragm type valve by turning in the small screw at the bottom of the spring housing until a 10 psi preload is obtained in the delivery line. A convenient way to determine this preload in the field is to disconnect the actuator arm from the throttle linkage, then observing the arm very closely, have another person slowly turn the adjusting screw on the valve until a slight movement is observed at the actuator arm. Then turn out the valve adjusting nut about ⅛ or ¼ turn. This preload adjustment should be used in throttle control lines only. Preloading clutch lines will result in serious damage to the clutch.

Trouble Shooting on Air System. Besides a normal complement of tools it is essential to have available an accurate air gage (0-300 psi) which is attached to a short length of hose. Assorted fittings are useful for connecting the air gage to various points in the system. Plug-in quick couplers are very convenient when bench testing pneumatic equipment.

Never break connections that are under pressure regardless of line size or pressure. Place tape over ends of disconnected tubing during maintenance work.

Leakage is a major source of air system troubles. It is difficult to completely eliminate leakage but it can be minimized by regular attention given to keeping fittings tight and the valves clean and lubricated. Excessive leakage can use up a major portion of compressor capacity. For example, a leak equivalent to a 1/16 inch diameter hole with 100 psi line pressure will discharge about five cubic feet per minute to the atmosphere. Excessive system leakage can put an air system out of service and cause damage to clutches due to low pressure. Use of flexible hose is recommended for installations where a lot of vibration is encountered. Pipe dope used in connecting lines should be of the non-hardening variety and applied sparingly to the first few threads of the fitting.

The first step in trouble-shooting an air system should be to check the supply pressure. Is it available all the way to the control console and at the valve supply ports? Do not trust the regular air tank gage. Pinched and obstructed lines should be repaired. Is the supply pressure high enough? When pressure control valves are used, the minimum supply pressure available at the valve must be at least 20 psi greater than the maximum delivery pressure expected from the valve. Low air pressure may be caused by an improperly set governor or by excessive leakage. Check all lines starting at the compressor. Bad leaks can be heard, even above rig noise, and smaller leaks can be located by the use of a liquid detergent soap solution.

If the air supply section is satisfactory, the trouble must be isolated by checking with the air gage in all lines starting with the inoperative device and interpreting proper operation from the air pressures obtained. Remember that large complete air systems are just a collection of small simple systems using one supply.

Slow clutch engagement may be the result of leakage or line restrictions caused by long line length, an excessive number of bends and fittings or obstructions in the line. Low clutch pressures can be caused by low supply pressure, excessive leakage, dirty valves and ruptured clutch elements. Slow clutch release can be caused by sticking of the quick release valves, excessive line length, an obstructed passage or an insufficient exhaust capacity due to incorrect adjustment of a valve element.

Slow or creeping throttle operation can be the result of leakage, excessive line length or too small an actuator mounted on the engine.

It is not difficult to trouble-shoot an air system when the function of all the components is thoroughly understood. The trouble can usually be isolated quickly. Study the rig manufacturer's service manual. Service literature for air valves can be obtained free by writing to the valve manufacturer. Knowledge is the most important tool in trouble shooting.

Complete repair of air equipment should not be undertaken in the field unless the person making the repair is experienced and familiar with the equipment. This is especially important in the case of pressure control valves. Field maintenance of air systems consist largely of keeping the air supply clean and dry, and the valves clean and lubricated. Valve repair or exchange with a factory authorized air control distributor can be the best assurance of uninterrupted service.

—The End

a checklist for engine maintenance ▸

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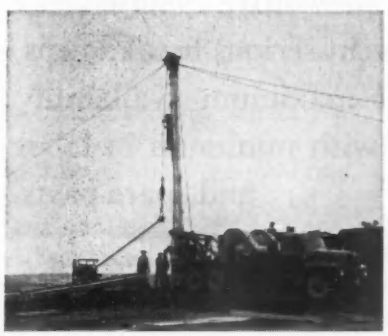

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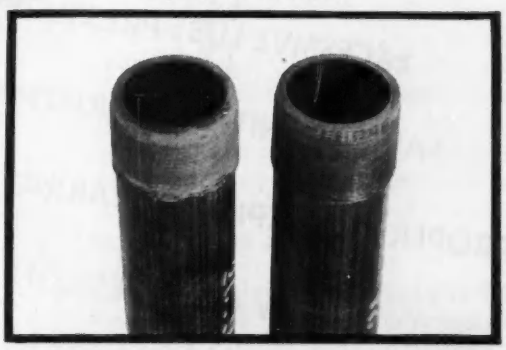
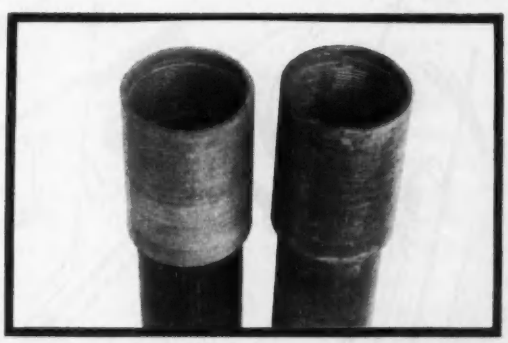


The tubing on the left above is new — the other was in a salt water well for 17 months.



There's no noticeable nor measurable difference between the new coupling on the left and the one that was in salt water for 17 months!

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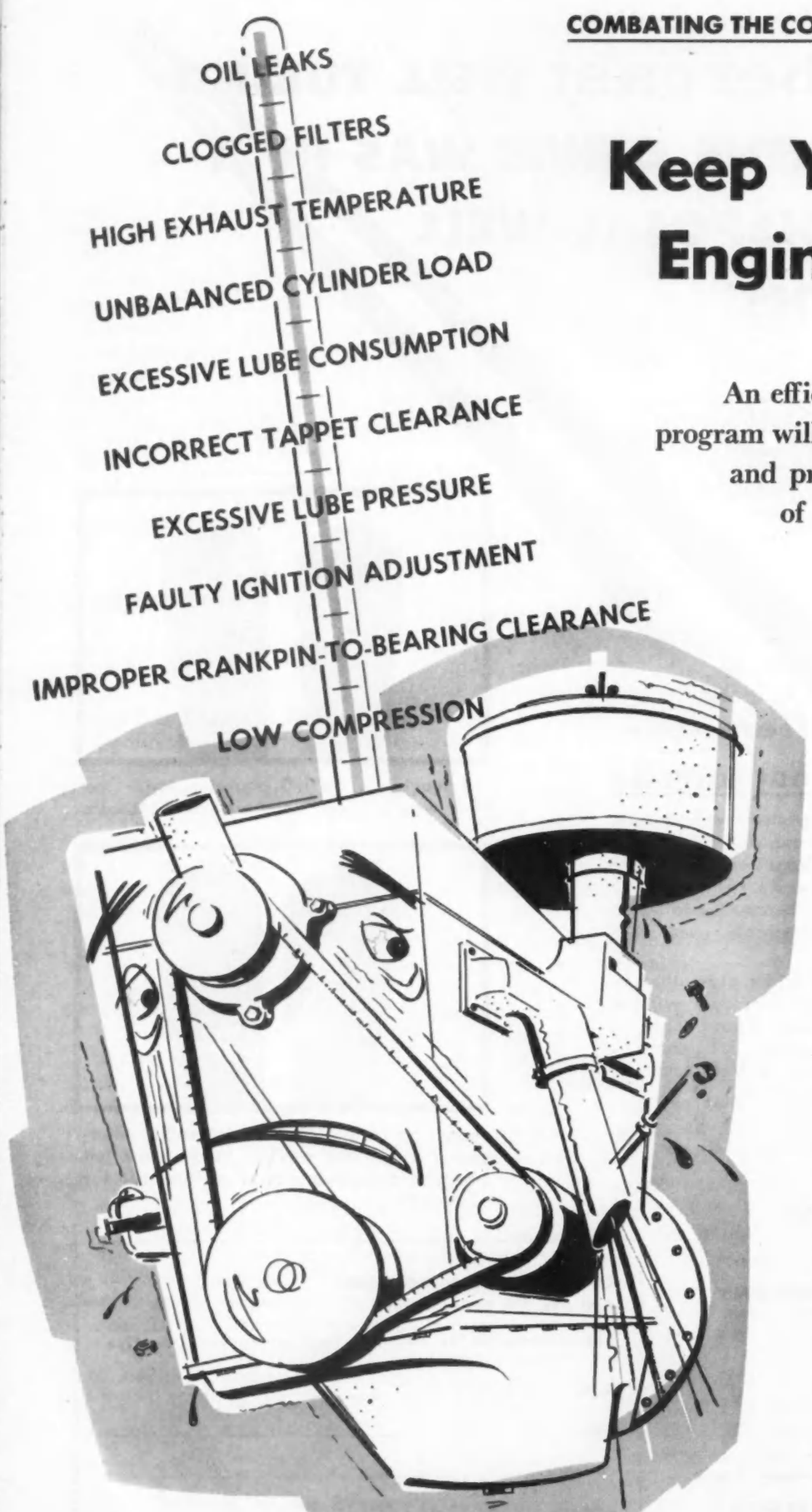
Keep Your Engines Healthy

An efficient preventive maintenance program will prevent serious breakdowns, and provide maximum availability of unit with minimum in labor and spare parts.



"Barometers" for Inspection that Indicate Trouble Ahead

By Jesse W. Kehres
Cooper-Bessemer Corporation
Mount Vernon, Ohio

FOR MAXIMUM EFFECTIVENESS, preventive maintenance of engines should be tailored to the individual company's operation. The primary reasons for this are the differences in equipment, service and personnel from one rig to another. The equipment will vary according to type of firing cycle, size, manufacturer, output ratings and type of mounting. Some engines will require uninterrupted operation for long periods of time, while others will allow shutdowns as required. The personnel will vary as to experience and their work habits in maintaining engines. Thus each rig must be studied separately to devise the most practical preventive maintenance program.

However, the basic principles of preventive maintenance are effective in any maintenance program. These same principles are used in maintaining the health of the human body. We all have occasion to employ a physician to aid us in maintaining our health. He makes certain checks to determine the conditions of vital parts

of our body and makes the repairs that are shown necessary. Although his efforts are usually beneficial, they will not keep us in good health unless we practice sound, daily health habits such as getting proper food and rest.

In maintaining the "health" of our engines, we too can make certain checks to determine the condition of vital parts and make repairs that are shown necessary. However, engines are not as consistent as the human body, and therefore constant checks on the engine must be made to be able to detect any change in engine condition. We call these checks "barometers" of engine condition.

This part of preventive maintenance cannot be truly effective unless we make certain periodic repairs and adjustments such as maintaining proper ignition, load balance, tappet clearance and stopping oil leaks.

Ignition Adjustment—This is one of the most important functions in the care of engines. Proper ignition adjustment not only affects engine operation but also some of the important "barometers" of engine condition. If ignition timing is retarded, high exhaust temperature and high fuel consumption will result. Advanced timing will produce high peak pressures. Non-uniform timing among cylinders will produce false balance as the cylinders with retarded timing will be overloaded and those with advanced timing will be underloaded. After placing the ignition system in good condition, determine how long it will operate free of trouble. Make the period between inspections somewhat shorter than this to insure good operation.

Balanced Cylinder Load—Another important periodic inspection is the balancing of the load among cylinders. Balancing by peak pressures has proved the most reliable method. The ignition should be in good condition before attempting to balance the load. An uneven load condition will result in some cylinders operating in excess of design rating and others under design rating.

In the first condition, rings and pistons will experience high rates of wear. High peak pressures can cause cylinder head and piston failures. In the second condition, poor combustion and excessive lubrication can cause carbon formation that will stick rings and valves, foul spark plugs and clog cylinder ports. Thus, a unit might have to be shut down to repair one or two cylinders and pistons while the general condition of all cylinders is good.

About the Author

JESSE W. KEHRES is an engineer in the Service department of Cooper-Bessemer Corporation, Mt. Vernon, Ohio, joining that organization in 1950. His duties involve analysis and corrective field problems relative to products design and operation. He holds a B.S. degree in mechanical engineering from Pennsylvania State University and is a registered professional engineer in the State of Ohio.

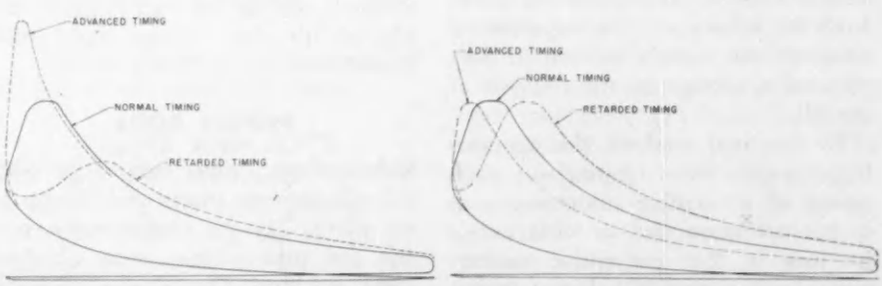
Tappet Clearance—The tappet clearance should be adjusted to proper value before balancing the load on two-cycle engines. Even though the load can be balanced with uneven tappet clearances, the cylinders with high tappet clearance will have shorter gas injection duration which may cause poor mixture and rough combustion. On four-cycle engines and some two-cycle engines, the inlet and exhaust valve tappet clearances should also be checked periodically to limit acceleration forces.

Oil Leaks—Periodic inspection also includes the control of oil leaks and general appearance of the engine. Accumulation of oil and grease makes working conditions unsafe. If the engine cannot be worked on, it cannot be maintained properly.

These points cover the major periodic inspections of preventive maintenance. Each rig will have other minor but important inspections and adjustments to make. If these inspections are performed thoroughly, keeping the "barometers" of engine condition will be easier and more meaningful.

Parts of the engine that should be covered by "barometers" will vary with the installation. Every installation should use "barometers" to tell the condition of piston rings, pistons, cylinders, connecting rod bearings and main bearings. Considerable time and labor is required to dismantle these parts for visual inspection. And disassembly of these parts may be harmful in itself as mating parts are disturbed, dirt introduced, and reassembly performed improperly.

Compression Pressure, Lube Oil Consumption, Crankcase Pressure—Piston rings, pistons and cylinders are related in function and the "barometers" indicating their condition are compression pressure, lube oil consumption and crankcase pressure. If rings become stuck, or rings and cylinder walls wear to the point where the rings can no longer seal properly, blowby generally results. Left uncorrected, the condition can cause serious damage to an engine. Blowby can be detected by a decrease in compression pressure, an increase in crankcase lubricating oil consumption and an increase in crankcase pressure. On four-stroke cycle engines, leaking valves will also lower the compression pressure, but they will not affect



If the ignition timing is retarded, the engine will experience high exhaust temperatures and high fuel consumption. Advanced timing will produce high peak pressures. Non-uniform timing among cylinders will produce false balance as the cylinders with retarded timing will be overloaded and those with advanced timing will be underloaded.

crankcase pressure or oil consumption.

Scavenging Air Pressure and Exhaust Temperature—Port carboning is often a problem with two-stroke cycle engines. Two good barometers of this condition are scavenging air pressure and exhaust temperature. As the ports carbon up, air is restricted, and the scavenging air pressure rises. Exhaust temperatures will rise and detonation may occur at rated load. If the engine is shut down periodically for port cleaning, there will be times when little or no carbon is present.

Crankpin-to-Bearing Clearance—With today's precision machining methods, bearings last indefinitely, depending on operating and maintenance conditions. Faulty assembly is one of the most injurious factors; it can occur even with the most skilled mechanics. Therefore, it is unwise to dismantle bearings for inspection. A good way of checking connecting rod bearings without dismantling is the crankpin-to-bearing clearance method. This can be checked with a dial indicator and jack. Main bearings can be checked through web deflections.

Lubricating Oil Pressure—Another check on main bearings is the lubricating oil pressure. A substantial increase in bearing clearance will generally lower the supply pressure.

Bearing Deposits—A constant check on lube oil filters and the engine crankcase will indicate impending bearing failures through deposits of bearing materials. Many operators find spectrographic analysis of the oil useful in determining the condition of not only the rod and main bearings, but any wearing part such as camshaft bearings, cam follower bushings, turbocharger bearing and the like. Generally the material specification of each of these parts will differ from the others, and the experienced observer can usually tell which part effected a change in the analysis of the oil.

In the final analysis, the operator must decide how important each phase of preventive maintenance is to his operation and to what extent he uses it. But preventive maintenance will give him a better understanding of his engines and provide peace of mind in knowing their condition at all times. —**The End**

COMBATING THE COST SQUEEZE

How to Keep Slush Pumps In Top Operating Condition

These few simple precautions, compiled from years of experience, can help you keep that slush pump operating properly.

SLUSH PUMPS AND their component parts are exceedingly rugged. Improvements are incorporated to take advantage of new manufacturing methods as they develop, and to meet the ever-changing requirements of drilling. However, continuing satisfactory performance is dependent upon three factors:

- Proper installation
- Operation
- Maintenance

All three of these are within the scope of the driller, and are essential to long pump life and trouble-free operation.

This article deals with field maintenance. By following these recommendations, the driller can extend the life of his slush pump and avoid shut-downs due to pump failure.

PISTON RODS

Lubrication. Proper lubrication with oil will increase piston rod life up to six times. The oil continuously cools the rod and washes away abrasive sand and mud. The oil also lubricates the rod packing, bushing and gland.

A low viscosity oil flowing freely around the rods gives the best lubrication and provides a constant oil film on the bearing surfaces. A little flake graphite in the oil is also beneficial.

Grease connections on the stuffing box should always be lubricated in accordance with manufacturers' instructions.

Stuffing Box Packing. Use a packing that does not require excessive gland pressure. Certain packings, though easy to install, and effectively stop leaks, are hard on rods.

Install the packing carefully and correctly, making sure it is not damaged. Packing which incorporates pressure-actuated sealing lips should be installed with the lips pointing toward the pressure seal-off. Do not tighten too much. Overtightening may cause extreme packing pressure on the rod. A packing that requires constant tightening of the glands is probably wearing out both the rod and packing. Avoid heavy use of the wrench on the gland adjusting nuts.

Put new packing on new rods, and renew frequently if sand or other abrasives are present.

Stuffing Box Parts. Keep stuffing box parts in good condition. The bushings and washers (junk rings) act

as bearings and must be maintained in top condition for good rod and packing life.

Installation Tips. Piston rods are precision made and require special care when they are installed if maximum service is to be obtained. Here are some specific recommendations which will make this equipment last longer.

Application of Pistons. The rod taper is made for a perfect fit, therefore all contacting surfaces on both the piston rod and the piston must be free of rust, grit, nicks, grease, etc. Extreme care is necessary to protect the taper because it is precision made for a perfect trouble-free fit. One small nick can cause a washout.

The following is a "rule-of-thumb" suggestion for tightening the various size rod nuts correctly:

API-3 One man on a 36-inch wrench.

API-4 One man on a 60-inch wrench.

API-5 Two men on an 8-foot (total length) wrench and cheater.

API-6 Two men on a 10-foot (total length) wrench and cheater.

Removing Pistons. Do not strike the rod with a sledge. Severe damage to both the piston and rod can result. Use a piston puller. The piston should be left on the rod taper until the piston is worn out. When reducing liner and piston sizes, use a separate set of rods.

Intermediate Rod Lock Nut. The intermediate rod lock nut must be kept tight and must be screwed on with the machined surface of the nut butting against the shoulder of its intermediate rod, and with the baffle plate facing the fluid end of the pump. A neglected, loose or reversed lock-nut can lead to a damaged intermediate rod, stripped threads on the piston rod, a "knocking" pump, or a broken rod and other pump damage.

PISTONS

Preventing Liner Washouts. A worn piston allowing a small leak is all that it takes to cause a complete liner washout. High pressure fluid washing across the piston ruins the liner in a few strokes. Money is saved and downtime reduced, by replacing pistons instead of liners. A damaged lip can also ruin a liner quickly.

Danger Signals. The following signs may indicate a leaky piston:

1. Fluctuating pressure.
2. Sound of by-passing fluid in pump.
3. Erratic stroking in a steam pump.

Storage and Handling. Handle pistons carefully. Lip damage can be prevented by keeping new pistons in their original box until ready for use.

Rubber deteriorates with age, particularly if subjected to heat for long periods. Therefore, do not keep too many pistons on hand at the rig. Check stocks regularly, and use up older pistons first.

Do not lay piston on its side for days at a time as the weight of the piston itself might cause permanent distortion of the lips. When pistons are on the rods, and storage is desired, it is good practice to construct a special rack to support the rods in a vertical position. Rod and piston assemblies should be cleaned and greased before they are placed in storage.

Installation. Treat pistons gently. Small nicks or cuts on lips contribute to early failure in service. Lubricate the piston and liner freely with graphite when installing to assure smooth operation during the priming period, and to avoid unnecessary piston damage. For good metal-to-metal contact between the piston and rod, make sure both are free of rust, dirt, mud and grease. A clean, tight fit will keep the piston from moving on the rod.

Do not put a new piston in a badly worn liner. Proper fit between the piston lip and liner wall is essential to long piston life. When inserting the piston in the liner, make sure the piston lip follows the chamber of the liner and does not "bend back" or get torn against the liner face.

Tighten rod nut carefully, using the rule-of-thumb previously given.

VALVES AND SEATS

Disc Renewal. Remember, the rubber disc is the most vulnerable part of the valve. Without it, the valves and seat will be ruined quickly. To prevent accelerated wear of the valve disc, clean between the disc and valve body or between the retainer plate and valve disc.

Inspect the valve disc for fluid cuts and pitting in the sealing area and replace worn discs before fluid washing cuts the valve body or seat.

Valve Spring Renewal. Check the valve springs and renew them if they are broken, distorted or have lost their tension. Make certain that the valves match up with the valve springs. Sometimes the height of the valve is such that the spring compresses completely before the valve fully opens, thus restricting flow.

Valve Seat Renewal. Periodically inspect valve seats for incipient fluid washing caused by foreign material holding the valve away from the seat. Make sure valve seats are firmly set in the pump. Clean each valve seat thoroughly before it is installed, removing all grease and oil, and particularly dirt and sand. Check the pump bore to be sure it is clean, then drive the valve seat in tightly, using a driver.

Never handle valves and seats as though they were so many pieces of pig iron. Sharp blows with metallic objects can damage the seating surfaces and discs. Do not put a damaged disc on a good valve and never batter the seat tapers.

Valve Stem Bushing Renewal. It's fake economy to save the price of a $2 or $4 valve stem bushing, and later find it necessary to spend $40 to $50, plus installation time, for a new valve seat.

A worn or out-of-round valve stem bushing can be a major source of valve and seat trouble. But since the bushing is not a moving part, its condition is sometimes taken for granted, and fluid end failures are incorrectly blamed on the valve and seat.

When a valve stem bushing becomes worn, or gets out of shape, the valve frequently becomes stuck or cocked, causing a loss of fluid efficiency and premature washout.

Check the diameter of the valve stem and valve cap bushing. Clearance should be approximately 1/16 inch for proper performance. Install new bushings regularly to be on the safe side.

LINERS

When to Replace Liners. Examine liners for signs of excessive wear or excessive corrosion. Discard liner if

severely grooved or well worn—as loss in piston life will offset gain in added liner life.

Since most pistons have a lip interference of approximately ⅛ inch on the diameter, liners worn more than ⅛ inch provide little or no contact—and will allow fluid to by-pass. As pressures increase, the allowable wear will decrease. Under very high pressures, liners worn as little as 1/16 inch to 3/32 inch on diameter may begin to give trouble. Therefore, it pays to measure the I.D. wear with calipers.

How to Avoid Liner Collapse. Loosen liner set screws and back them out several turns before tightening cylinder head stud nuts. This procedure is necessary because, as the liner packing may pack before the head seats. If the set screws are not properly backed out and reset, they will put excessive pressure on the new packing and bulge the liner, causing serious damage.

Installation and Maintenance Tips. Clean the liner thoroughly, inside and out, before installing.

Clean the pump bore thoroughly. Smooth out any nicks or burrs. Make sure that the "Tell-Tale" holes in the pump casting are open.

Liners should not be left installed in an idle pump for any length of time. Rust, sand and hardened drilling mud will render them very difficult to remove, and the liner sleeves may deteriorate enough to necessitate renewal.

PACKING

Valve Cap and Cylinder Head Packing. The limited life of valve cap and cylinder head gaskets can be increased by taking a few precautions:

1. Proper storage of replacement gaskets in separate bins or cardboard boxes will protect them from cuts or abrasion.

2. Avoid overstocking: Keep only enough gaskets at the rig to satisfy immediate demands because they deteriorate with age . . . especially in hot climates.

3. Install with care: Insert each gasket properly in its groove or retainer, making sure that all metal surfaces are clean and free from sand and rust.

Liner Packing. Make certain sleeves are sufficiently hard to resist extrusion and pinching, yet are not too brittle. Use flake graphite on sleeves to lubricate them and help prevent vulcanizing to the pump casting and liner.

Always use liners of correct O.D. Undersized liners cause a major portion of packing troubles since too much clearance causes packing to extrude, and results in early failure.

How to Use the Tell-Tale Hole. Mud oozing out the "Tell-Tale" hole in the cylindrical casting of the fluid end indicates a leak around the packing between the liner and the fluid cylinder.

If this leak is not remedied, drilling fluid washing back and forth past the packing will wash out the cylinder liner or the fluid end casting in a surprisingly short time.

What to Do When Mud is Sighted in the Tell-Tale Hole.

1. Tighten packing by tightening the liner set screws in the cylinder head.

2. If the leak does not stop, disassemble and replace the two rubber sleeves which form the seal.

Keep the Tell-Tale Hole Clean. Obviously, if the Tell-Tale hole is blocked or clogged it will not function properly. Clean the pump bore thoroughly after each liner change and make sure no bits of old packing or other debris are obstructing the hole.

STUDS AND LINER SET SCREWS

Rotation of Tightening Nuts. When the cover plate is installed, tighten the nuts alternately 1-5, 2-6, 3-7, 4-8, 5-9, etc. in a crisscross manner. Never tighten one or two nuts excessively; tighten all evenly. Failure to do this will lead to stud breakage.

How to Reduce Costly Stud Breakage. A set of valve cover plate studs will generally last two or three years depending upon slush pump use, loads applied etc. When a stud breaks, the following steps are recommended:

1. If one stud breaks, renew all studs on that valve pot. If one stud has been stressed to the breaking point, the chances are that others have also. Additional failures will probably occur . . . causing overloading of the studs and shortening their life.

2. Install the new studs by trying a nut on the stud—the end on which the nut fits tightly goes into the pump casting.

3. Run the studs in all the way. Do not leave several studs half installed.

4. Clean studs, clean nuts and clean stud holes are conducive to long stud life.

MAINTAINING GOOD PUMP SUCTION

Proper suction manifolds give added service to both pump and pump parts because they assure complete filling of the fluid cylinder and minimize hammering and destructive pressure peaks. These rules-of-thumb result in better slush pump suction:

1. Use mud tanks to provide a flooded suction head. Avoid depressed mud pits wherever possible.

2. Keep suction pipe friction to a minimum by avoiding bends in suction line, suction hose with torn lining, and excessive use of tees and elbows. Make sure suction strainer is kept clean to insure unrestricted mud intake; if foreign material can be eliminated, do not use a suction strainer.

3. Use a short suction line of large diameter to further reduce friction—this will also help to minimize harmful inertia effects in the suction line.

4. Arrange pits or tanks to provide adequate cooling surface for the mud. "Hot" mud speeds up deterioration of rubber parts (pistons, valve inserts and liner packing) in the fluid end. The water in hot mud may boil in the cylinder because of the low pressure condition existing on the suction stroke.

5. Separate the gas and air from mud by using baffles. Entrained gas expands in the fluid cylinder on the suction stroke and lowers suction efficiency.

Factors Which Reduce Pump Efficiency.

1. Suction line too long.
2. Suction strainer too small.
3. Too much lift from pit or tank.
4. Too many bends in line.
5. Suction line diameter too small.
6. Worn suction hose.

Starving the Slush Pump of Ample Fluid at Each Stroke Leads to:

1. Hammering and shock loading
2. Shorter bearing life.
3. Poor lubrication of pistons with consequent piston and liner failure.
4. Shorter valve and seat life.
5. More downtime for overhauls.

ACKNOWLEDGMENT:
Information contained in this article represents results of care and maintenance surveys conducted by The National Supply Company engineers over a period of years and is published as a service to the drilling industry.

Keys to Successful Competitive Drilling

Part 5B

A series on modern drilling technology—functions of the drilling fluid.

By Roy A. Bobo and Robert S. Hoch
Drilling Engineering Department
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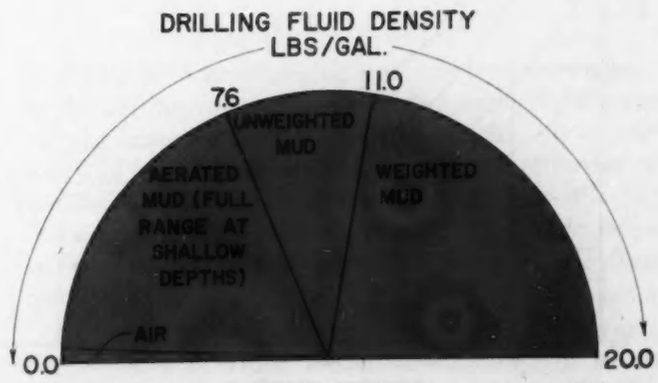
Drilling Fluids and Circulatory Systems. Both the system and the type of drilling fluid which is employed are dependent upon the nature of the area and whether formation fluid pressures that are encountered are abnormal, normal, or subnormal. The majority of wells are drilled in normal to subnormal pressure areas where unweighted muds are sufficiently heavy to control any anticipated formation fluids. Weighted muds are in wide use below 10,000 feet on rigs along the Gulf Coast and in certain other areas where drilling is carried to great depths. More unconventional is the method of employing air as a circulating agent in subnormal pressure regions where part or all of the hole will be dry. Experimentation continues with a still more radical approach known as aerated mud drilling in order to overcome the current disadvantages of air drilling. Figure 24 represents the ranges in densities of the drilling media that are possible with each of the circulatory systems previously described.

Relief of Formation Stress. Other properties remaining unchanged, it is generally true that the less dense the drilling fluid, the greater will be the penetration rates and bit footages which are possible. The reason for this lies in the physical characteristics of rocks under stress, which have a pronounced influence on the energy requirements for fracture by action of the bit teeth, and the resulting volume of dislodged formation.

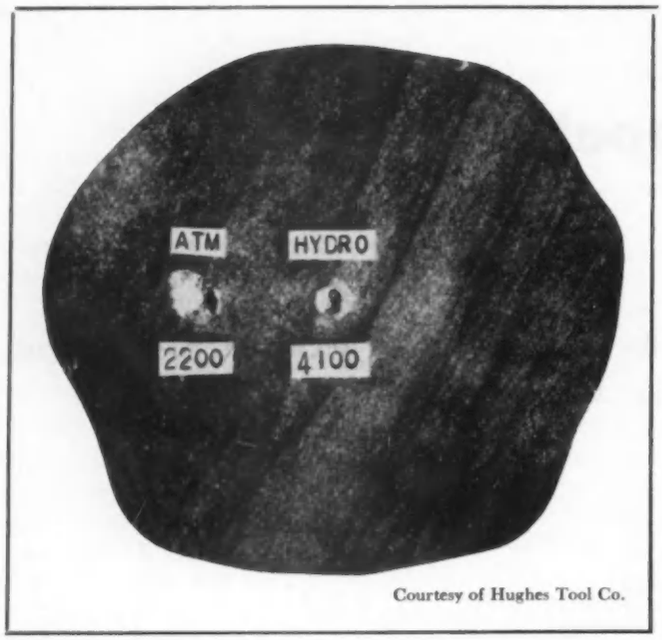
It is well known that formations buried beneath the earth's surface are in a state of stress, due to the weight of the overburden, and to any horizontally applied tectonic forces which may exist. In general, the compressive forces to which rocks are subjected will increase with depth, and may be somewhat dependent upon other geological factors, such as whether the terrain is mountainous or flat, how long quiescent the age, etc. As a notable example, compaction from the pressure of the overlying beds brings out a decrease in the porosity of shales from as much as 50 percent for clay at the surface to 5 percent at 6000 feet.[7]

Laboratory Investigation—Effect of Confining Pressure. Recent laboratory work has shed light upon the behavior of rock under the earth's stress, by simulation of certain specific conditions. Bredthauer[8] subjected several dry and jacketed specimens of each of 13 rock samples to compressive axial loading for confining pressures which ranged from atmospheric to 15,000 psi. All specimens showed greater compressive strengths with increases in confining pressure. Brittle behavior was obtained at atmospheric pressure on all formations so tested. Under the effects of confining pressure, many formations which had relatively low compressive strengths at atmospheric pressure experienced a brittle to ductile transition prior to failure. When these formations were exposed to hydrostatic pressures of 10,000 psi, and lower in some cases, large amounts of deformation occurred prior to fracture. Handin and Hager,[9] commenting upon the enhanced ductility and strength of rock by confining



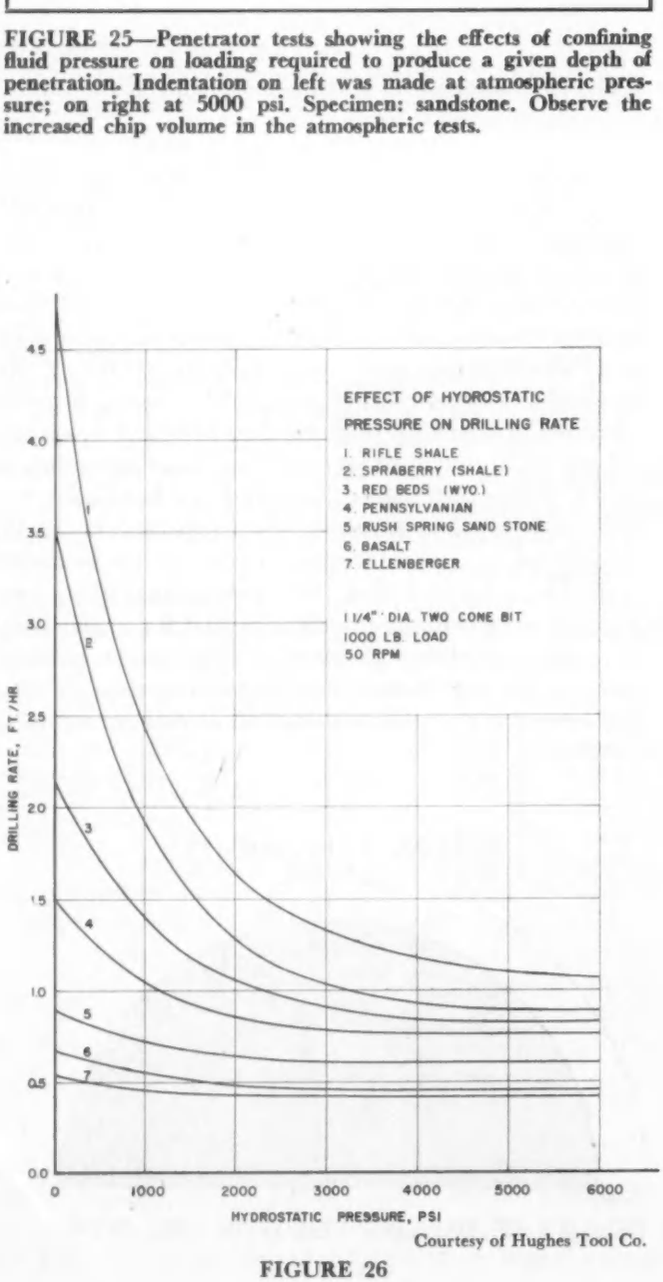
DENSITY OF DRILLING FLUIDS IN USE TODAY

FIGURE 24



Courtesy of Hughes Tool Co.

FIGURE 25—Penetrator tests showing the effects of confining fluid pressure on loading required to produce a given depth of penetration. Indentation on left was made at atmospheric pressure; on right at 5000 psi. Specimen: sandstone. Observe the increased chip volume in the atmospheric tests.



Courtesy of Hughes Tool Co.

FIGURE 26

pressures, stated: "the energy required to fracture a material is proportional to the area under its stress-strain curve, which area, and hence energy expended, increase to some degree with confining pressure."

Bredthauer found that the ultimate strength and ductility of unjacketed permeable specimens which were saturated with the pressure liquid were unaffected by confining pressures. In such case, the rock compressive stress which would exist as a result of the drilling fluid pressure is nullified by the equalization of the fluid pressure within the pores of the specimen. Conceivably, the specimen should then fail somewhat similar to one that is tested at atmospheric pressure. Only the strength of the individual grains which surround the pore space is increased.

Effect of Drilling Fluid Pressure on Drillability of Rock. The stress pattern of the formation below and around the bit has not been accurately ascertained by theory or test. Determination of the stresses at the bottom of the hole is visualized as an exceedingly complex problem, dependent upon the degree of plasticity in the rock being drilled. The axial (vertical) stress in the formation below the bit, within the depth affected by tooth action, will be influenced by the pressure that is exerted by the drilling fluid. Field experience has proven that this axial stress has a major control over bit performance.

The axial compressive stress at the rock face below the bit will be a direct function of the density of the drilling fluid. In low permeability rock, the downward force from the pressure of the drilling fluid is transmitted through the granular or inter-crystalline structure of the formation, thereby increasing its compressive strength. In general, the weight of an unweighted or weighted drilling fluid is sufficient, even at moderate depths, to increase the compressive strength of most formations. Some shales and limestones which would be brittle at the surface are in a plastic state in their native environment. When penetrated by the bit, these rocks will often retain some of their inherent plasticity due to the stress imposed by the drilling fluid. Compared to drilling of surface rock, the increasing axial stress with depth and/or fluid density not only changes the shape, but also reduces the volume of formation particles removed for a given depth of tooth penetration. In addition, it increases the amount of bit loading necessary to effect a given depth of tooth penetration. This is further illustrated by laboratory work as described in Figure 25.[10]

Cunningham[11] has demonstrated the effect of confining pressure on drilling rates in seven different formation specimens, all having low permeability. For his experiments, Cunningham used a 1¼-inch two-cone micro-bit loaded to 1000 pounds to drill specimens that were surrounded by a drilling fluid consisting of water and an inhibitor. These results for various confining pressures are shown in Figure 26.

Equalization of Axial Compressive Stress in Porous Rock. As has been stated, the axial stress at the rock

face beneath the bit is controlled by the pressure of the drilling fluid and this pressure is transmitted downward through the inter-crystalline or inter-granular structure of the rock. For porous, permeable rock, the compressive effects of drilling fluid pressure may be partly or wholly nullified by the equalization of pressure within the pores (Figure 27). The degree of stress equalization will depend upon the difference between the pressures of the drilling and the interstitial formation fluids. Where high viscosity or filter cake formation prevents entry of, or transmission of pressure by the drilling fluid into the formation ahead of the bit, the inter-granular compressive effect will be the greatest and similar to that discussed for low permeability rocks. Conversely, where the properties of the drilling fluids permit rapid entry and equalization of pressure in the rock pores, the effects of the axial compressive stress will be most relieved.

Equalization of Axial Compressive Stress During Bit Tooth Penetration. When drilling a rock that is subjected to axial compressive stress, the rock removal efficiency is related to the ability of the drilling fluid to penetrate the fracture or shearing plane being formed during actions of the bit teeth. In rock of low permeability, the pressure in the fracture space will be zero if the fluid cannot readily enter as the crack is being propagated. A pressure differential equivalent to the bottom hole drilling fluid pressure will then exist across the chip being formed. This will result in sliding friction along the fractures or shear planes, which will increase the amount of energy required to (1) complete the fracture or (2) in the case of a shear plane, effect a given amount of formation displacement. Fluid mobility in fracture and pore spaces is related to the viscous properties of the fluid (but not necessarily the API water loss[12]). It is obvious that the greatest fluid mobility would be achieved with air or gas, followed by water and then muds of increasing viscosity.

From this, it should be reasonable to conclude that the best drilling fluid, from the standpoint of bit performance, should be one having the following properties:

1. *Minimum viscosity and maximum filtration rates* (not necessarily API water loss) *to facilitate fluid entry into pore spaces and/or fractures formed during tooth action.*
2. *Minimum fluid density in order to afford the greatest possible relief of bottom hole pressure, which in turn relieves those intergranular and/or intercrystalline forces which resist tooth penetration.*

CLEANING BENEATH THE BIT

Factors Influencing Fluid Energy Requirements for Cleaning Beneath the Bit. The fluid energy requirements for cleaning the hole below the bit are dependent upon the character of the formations to be drilled under the stresses which are imposed. Extremely soft formations tend to extrude upward between the bit teeth and cones as load is applied to the bit. The vertical impact force

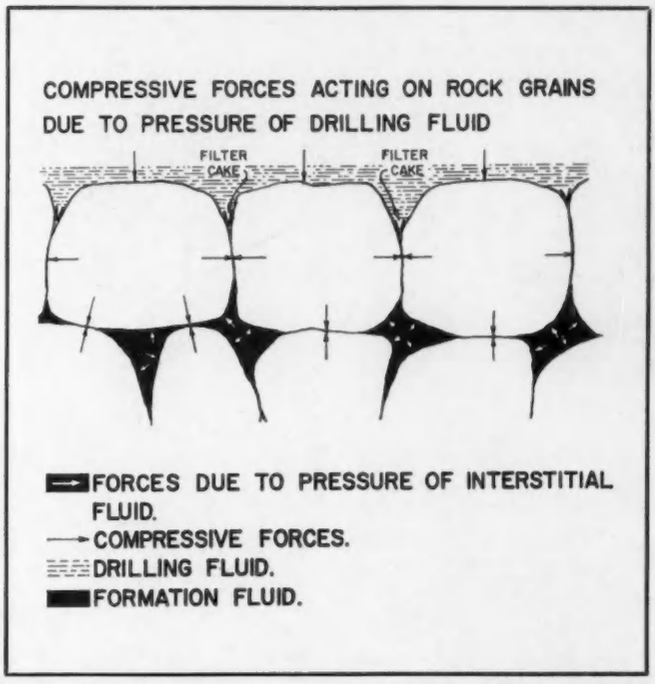
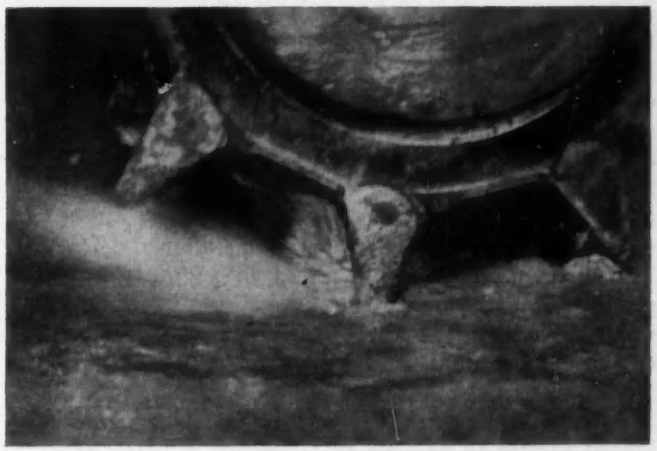


FIGURE 27—Showing how forces due to pressure of fluid in pore space tends to neutralize inter-granular compressive effects of drilling fluid hydrostatic pressure.



Courtesy of Hughes Tool Co.

FIGURE 28—In this test a formation is being drilled with air at atmospheric conditions. Note the explosion of particles away from the bit tooth.

of the fluid stream emerging from the jet bit contributes to the disintegration of this extruded mass. The diverted velocity energy is further expended, eroding the exposed wall and bottom hole surfaces. In this type of formation, the downward progress of the bit or the rate at which this extruded mass can be disintegrated, is directly related to the total energy of the jet stream at the nozzle exit.

As the formations become harder and tougher, as in the majority of cases, formation rupture will be the result of the gouging, chipping, crushing, or extruding actions of the rock bit teeth. Most of the Gulf Coast

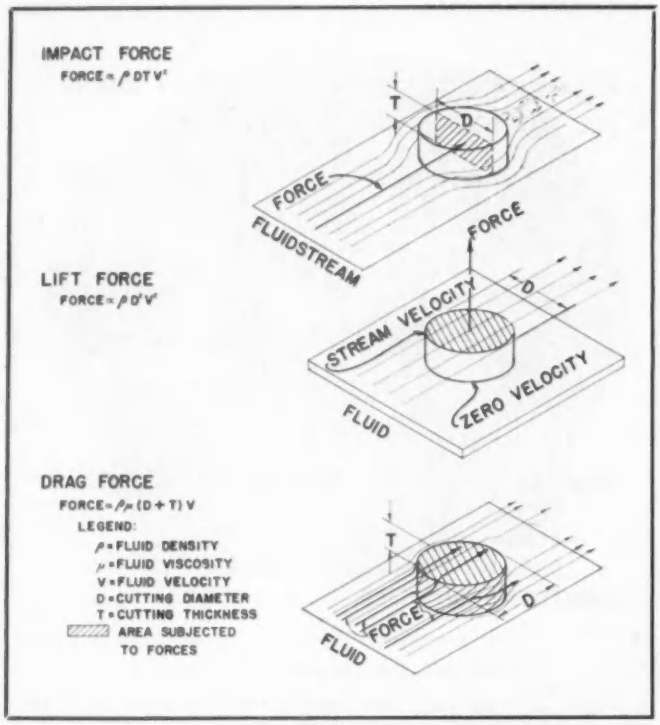


FIGURE 29

shales, though brittle when conveyed to the surface, are known to be quite ductile and tend to produce an extrusion around the penetrating tooth rather than a chip. However, West Texas dolomites, quartzites, cherts and other formations, having high atmospheric compressive strength, remain brittle at great depths. In these, tooth action tends to produce chips.

In certain cases, some of the bit cuttings can move away from the bottom hole surface as a result of the strain energy released by the cutting after the fracture is completed. This is illustrated in Figure 28, which shows the cuttings actually "exploding" from a formation being drilled at atmospheric pressure using air as the circulation fluid.

Forces Tending to Hold Cutting in Place. Every dislodged formation particle that remains in place beneath the bit, is subjected to a vertical downward force which tends to resist the removal forces generated by the drilling fluid. Some of these retention forces are:

1. Buoyed Weight of the Particle.

2. Wedging Force: During tooth penetration, the original cohesive and/or adhesive force which binds the particles may have been broken to cause pulverization: but the high compressive forces transmitted from the bit tooth through these particles may result in wedging and the reforming of cohesive forces between these particles.

3. Pressure Differential Forces: This force exists when the fluid pressure above the dislodged particle is equivalent to the product of the differential pressure and the projected area of the particle. It is almost negligible at shallow depths and where the drilling fluid penetrates the pore space at a rate greater than that of the bit.

Particle Removal Forces of the Drilling Fluid. Once formed, the dislodged particles should be quickly removed from the surface beneath the bit to prevent their regrinding. Their removal can be accomplished only if the removal force supplied by the drilling fluid exceeds the total retention force previously described.

The total removal force is the result of the fluid velocity action upon the exposed surfaces of the dislodged particle. This may be comprised of one or several force components—depending on the size and shape of the particle, viscosity and density of the fluid, and the fluid velocity acting upon the particle surfaces. These removal forces are illustrated in Figure 29 and are defined as follows:

IMPACT: This is the force resulting from fluid impingement against the exposed surface and is directly proportional to the projected area (at right angles to the flow stream), of the impact surface, the fluid density, and the square of the fluid stream velocity (V^2). This force is not affected by the viscosity of the fluid.

LIFT: A high velocity across the top of the surface of a cutting which is surrounded by the drilling fluid with little or no velocity below the cutting will result in a lift force similar to that on an airplane wing. This force is proportional to the projected area of the lift surface which is parallel to the flow stream; the fluid density; and the square of the fluid velocity. This force is not affected by fluid viscosity.

DRAG: This force predominates with small cuttings only, when the fluid velocity is low and/or the viscosity is high. It is directly proportional to the velocity, viscosity, and particle diameter.

In many situations, the medium or larger sized cuttings will be the most difficult to remove. Lift and impact forces will comprise most of the total removal forces. Therefore, the total force per unit of area tending to move these cuttings will be proportional to the density of the fluid (ρ), and the square of the fluid velocity (V^2) acting upon the exposed cutting surfaces.

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Another Installment Next Month

The third section of Part 5 of this series will appear in the November issue of WORLD OIL and will discuss the rotary hydraulics and some of the variables that must be considered in good conventional and jet drilling practices.

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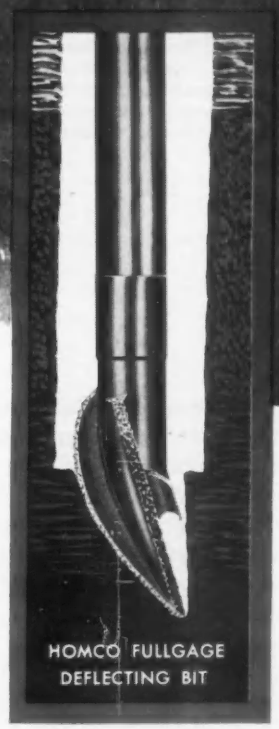

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Development and field testing of . .

Wireline Retractable Rock Bits

Three-cone and four-cone rock bits run in on wireline and turned with the casing have shown encouraging results in both the laboratory and on controlled field tests.

By J. M. Camp, J. E. Ortloff and R. H. Blood
Carter Research Laboratory, Tulsa

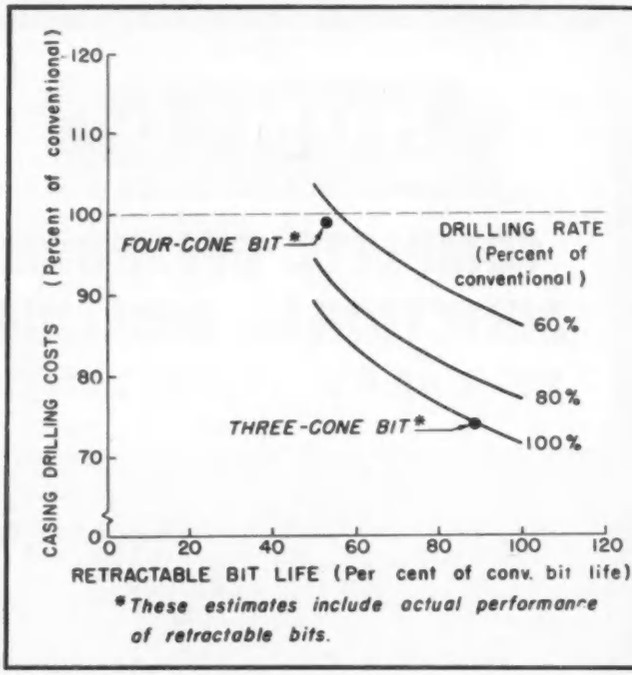

FIGURE 1

The cost of drilling with retractable bits and casing is shown in Figure 1 as a percentage of the costs of drilling with conventional methods when related to various drilling rates and bit life. The four-cone retractable bit (Figure 2) removed and inserted cones in pairs. This hampered the size of the cones and necessitated smaller bearings that resulted in shorted bit life. In the special

DRILLING WITH casing and retractable rock bits shows promise of being a money-saving drilling practice of the future. Recent tests run on 7500-foot wells in the Mid-Continent area show savings up to 25 percent as compared with the cost of standard rotary drilling (The term "drilling costs" as used here refers to the penetration or contractor's portion of total well costs).

Drilling with casing and collapsible drag bits is not broadly new. Before muds were developed to control heaving shales, this method was used in penetrating such shales in the Gulf Coast and East Texas. This early casing drilling permitted shale sections to be penetrated without pulling pipe to change bits, the casing being carried to total depth and cemented in place.

Figure 1 shows the estimated cost of drilling with casing as a percent of conventional drilling cost when related to various drilling rates and lengths of bit life for retractable bits. The predicted savings for casing drilling were based on reductions in time, equipment, investment, and labor resulting from the elimination of trips with drill pipe to change bits. Reduced equipment investment is considered possible because the need for high-powered, high-speed hoisting equipment to make rapid round trips is eliminated. The only equipment required is that for adding single stands of pipe or for handling occasional emergency pulling operations at slow speed.

In the drilling system analyzed, 7-inch OD streamlined casing was selected for the drill string. Two retractable rock bit designs were considered: a four-cone and a three-cone. The bits pass in a collapsed position through the casing bore and then expand to cut a hole large enough (9¾-inch diameter) to pass the casing. The bits are transported in and out of the hole by a swabbing, or sand, line.

Since round trips with pipe are not required, it was assumed that the mast for adding single casing joints would be shorter than standard length, and that less hoisting power would be required. One crewman would be eliminated. Rotation and circulation would be conventional except that a special casing drive would replace the standard rotary kelly and bushing.

Development of a four-cone retractable bit was started first, and later the three-cone bit was built. The cutters and cutter legs for both retractable bits were manufactured by the Hughes Tool Company, Inc. The upper mandrel assembly and sinker bar for the four-cone type were made by Houston Oil Field Material Company.

Operation of the Four-Cone Bit. The four-cone bit was designed to carry the collapsed cutters in pairs for making round trips. Figure 2 shows the special drill collar receiving the bit. When the two spring dogs contact a shoulder near the bottom of

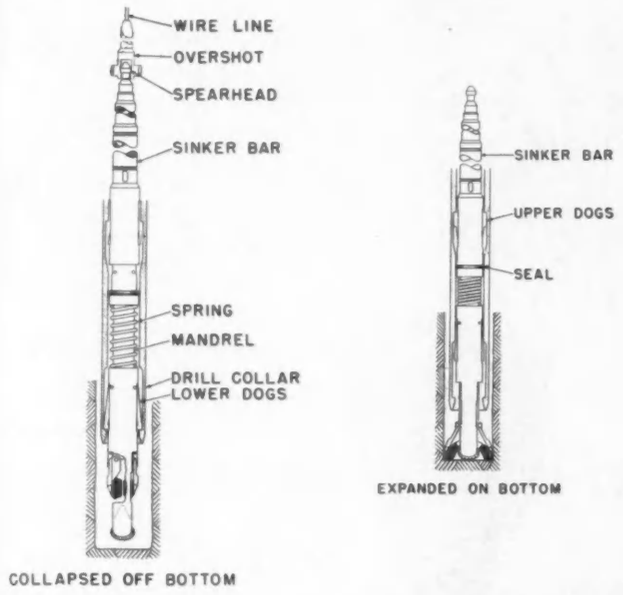

FIGURE 2

FIGURE 3

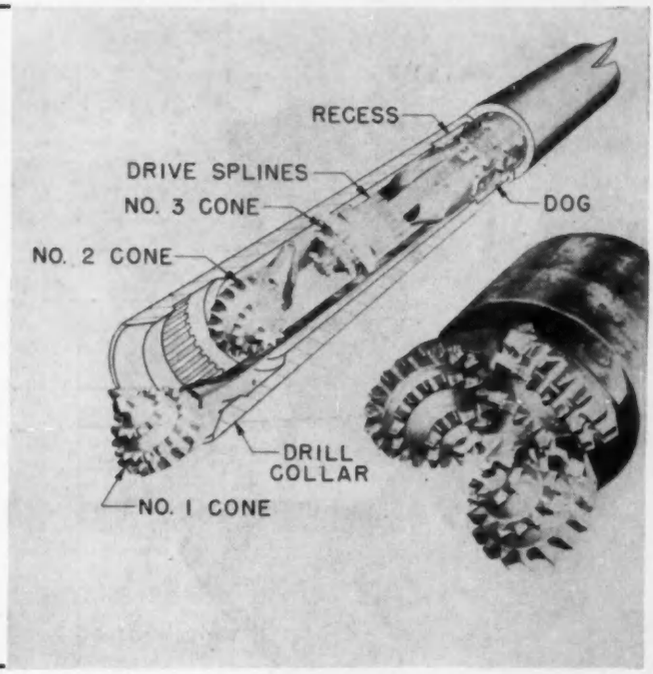

FIGURE 4

drill collar shown here, the downward movement of the two center cutters is stopped when the spring dogs contact the shoulder near the bottom of the collar. After the cones are in place and expanded, the overshot is released and the cable is reeled out of the pipe. In Figure 3, the casing is lowered until the bit reaches bottom and the drilling weight is transferred to the upper dogs. Drilling torque is provided by a drive lug extending down from the upper shoulder. Figure 4 is a cutaway view of the three-cone bit where the cones are run in single file and then expanded to full gage. This three-cone bit permits the use of larger cones and consequently larger bearings, insuring longer bit life.

the drill collar, they stop the downward movement of the two center cutters.

A sinker bar at the top of the bit pushes the two hinged outer cutters against a wedge (supported by the dogs) and the wedge in turn forces the outer cutters out to gage diameter. At the same time the heavy spring is compressed and the upper latching dogs are carried past a downward-facing shoulder near the upper end of the bit assembly. The seal is expanded to fit the bore of the drill collar. The overshot, which is attached to the cable, is released from the bit spearhead when a tripping sleeve is dropped down the cable from the surface. The cable is then reeled from the well.

The casing is lowered until the bit reaches bottom and the upper dogs carrying the drilling weight as shown in Figure 3. A drive lug, extending downward from the upper shoulder transmits drilling torque through one of the upper dogs to rotate the bit.

Mud coming down the casing bore is diverted by the seal through ports and down the center of the bit body. The stream is divided into two jets which strike the bottom of the well between the outer and inner cones.

Worn-out bits are replaced by reversing the above procedure. The casing is picked up enough to permit the surface connection to be broken and the pipe to be hung in the slips. The cable and overshot are lowered over the spearhead and the collapsed bit is pulled to the surface.

Operation of the Three-Cone Bit. The three-cone bit was designed to use the largest cones that could possibly pass through the bore of the casing. To do this, the cones are arranged in single-file when the bit is collapsed. Figure 4 shows the bit collapsed in a cut-away view of the special drill collar designed to receive the bit. Also in Figure 4 the bit is shown expanded to full drilling diameter.

The bit is lowered on a cable and special overshot through the casing. Each cone is stopped successively by contact of separate spring-loaded dogs in the locking recess. Thus all three cones are positioned at the lower end of the drill collar. The heavy central mandrel (to which the cone carriers are slidably attached) continues downward to wedge the cone legs outward against the lower end of the drill collar bore. Corrugations (or splines) in the casing bore engage the outside of the cone legs to transmit torque directly from the drill collar to the bit. Thus a direct method is provided for driving the three-cone retractable bit. For the four-cone bit, dogs transmit torque and weight into the mandrel several feet above the cutters.

An expanding packer is held down by two latching dogs (not shown in the figure) near the upper end of the bit assembly. The packer diverts drilling mud through the bore of the mandrel and out through a nozzle at

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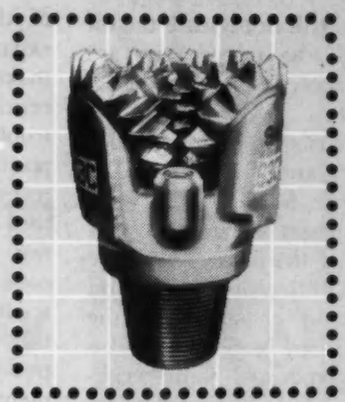

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the lower end. The fluid jets the bottom of the hole slightly off center.

The overshot will not release the bit spearhead until the upper dogs are seated in the recess of the drill collar.

Tests. The four-cone bit was field-tested five times, and drilled a total of 1142 feet of hole. Modifications were made as weaknesses showed up during the course of the field tests. Some of the major difficulties were sand deposit and sand erosion near the seal, nozzle erosion, inability to ream undersize hole and tool joint weakness in the mandrel. With these defects corrected the retraction and expansion of the bit became quite reliable.

During most of the tests drilling weights and rotating speeds were about the same as those for conventional drilling in the test areas near Seminole, Oklahoma.

Table 1 shows the average drilling rate and average bit life of the four-cone bits for each field test. These are expressed in percent of conventional bit performance in the same area.

The generally low performance level of the four-cone bit was the result of the small size of the cones as compared with that of standard bit cones for the same 9¾-inch hole size. The cutter size determines the size and load capacity of bearings, the number and size of teeth, and the strength of the cone shell. Thus unit load and resultant wear are higher per tooth in the smaller cones.

The three-cone bit was laboratory-tested by the bit manufacturer before field drilling tests were made. In these tests the bit was compared with conventional tricone bits, both being run in the same rock and at the same weight and speed. Drilling rates were equal. In a bearing life test, run on a steel block in drilling mud, the retractable bit ran at 60 rpm for 45 hours at loads that totaled 657.5 ton-hours. Broken and damaged bearings in two of the cones stopped the bearing life test.

The three-cone bit was field-tested twice near Seminole, Okla., during which 421 feet of hole was drilled at rotary speeds and drilling weights commonly used in the area.

Mechanical trouble occurred mostly with the expansion of the bit. In one instance the third cone would not go entirely into drilling position because the casing was lying against one side of the hole. This prevented proper expansion of the first two cutters to make room for the third. Suitable centralizers were added to correct this trouble. In a later test one of the positioning dogs passed the drill collar recess and the cone protruded below the other two cones. When the bit was set on bottom and rotated, the cone and carrier were damaged. Later trials in the drilling laboratory showed this trouble to be caused by a dash-pot action that retarded the movement of the positioning dog. This difficulty was readily remedied.

Table 2 shows the average drilling rate and bit life of the three-cone bit, calculated from field tests. Again, these are shown as percent of conventional bit performance in the same area.

As shown in the table, the three-cone retractable bit performance compares very favorably with that of conventional tricone bits. This is attributed to the relatively large size of the cones in this model, which approach conventional cone size. Although a slightly higher drilling rate was recorded, the amount of hole drilled was limited. The drilling rate is therefore considered equal to conventional.

Status of Development. It was felt that after having proved field operability, any further development could be done more efficiently by an organization equipped for specialized machining and metallurgy work. Both retractable bit designs have been licensed to a major bit manufacturer on a nonexclusive basis.

TABLE 1

Test	Field	Average Drilling Rate (Percent of Conventional)	Average Footage (Percent of Conventional)
1	Searight.....	90	66
2*	N. W. Perry....	..	..
3	Seminole.....	55	53
4	Konawa.....	67	36
5	Seminole.....	41	46
	Total Average..	65	55

* Insufficient hole was drilled during this test to determine comparative drilling rate and bit life.

TABLE 2

Test	Field	Average Drilling Rate (Percent of Conventional)	Average Footage* (Percent of Conventional)
1	North Earlsboro	102	92
2	Seminole.....	120	87
	Average.....	111	89

* Based on engineers' estimates of partially worn retractable bits.

Possible Applications of Retractable Bit Principle. Economic analysis of retractable bits as shown in Figure 1 was based mainly on their use as a means of drilling wells to producing depths without the time loss of round trips or the costly rigs necessary for frequent fast trips. Also, conventional hole size and essentially conventional practice were assumed.

Several extended uses have been suggested. Drilling down surface casing in areas of caving surface formation is one. Slim hole drilling with non-roller cutter retractable bits (to eliminate the bearing problem) is another. Retractable diamond bit cutters are a possibility. Another possible field of use is in conjunction with reelable down-hole powered drills driven by fluid power, electrical energy or otherwise.

Results and Conclusions. Economic studies based on conventional mid-continent well costs indicate that the three-cone retractable bit, under proper conditions, could save about 25 percent of penetration costs in 7500-foot drilling.

The savings to be expected from drilling with casing should increase with depth, because trip time increases. In wells shallower than about 4500 feet the streamlined drill casing must be replaced by cheaper API casing to save money.

The development work done so far has produced reasonably workable bits that stand a good chance of practical usage. To fully realize the economic benefits of drilling with casing, surface equipment should be tailored for the process. Development of additional uses for retractable bit mechanisms is recommended.

ACKNOWLEDGMENTS

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Hughes Tool Company and Houston Oil Field Materials Company, Inc., extended cooperation in the design and manufacture of components of the retractable bits.

This paper was presented at the annual meeting of the Petroleum Branch of the American Society of Mechanical Engineers in Tulsa, Sept. 23-25, 1957.

Modern Light-Weight Drilling Strings Gaining in Popularity

Development of special tool joints leads to improved performance. Fifteen strings soon will be in Venezuela, where two strings have given excellent service in drilling nearly 500,000 feet of hole.

By Warren L. Baker
Editorial Director, WORLD OIL

USE OF LIGHT-WEIGHT drilling strings is expanding rapidly. More drill pipe weighing under 14 pounds per foot will go into service during 1957 than in all previous years combined. Behind this sudden growth is a record of improved performance since the development of special tool joints.

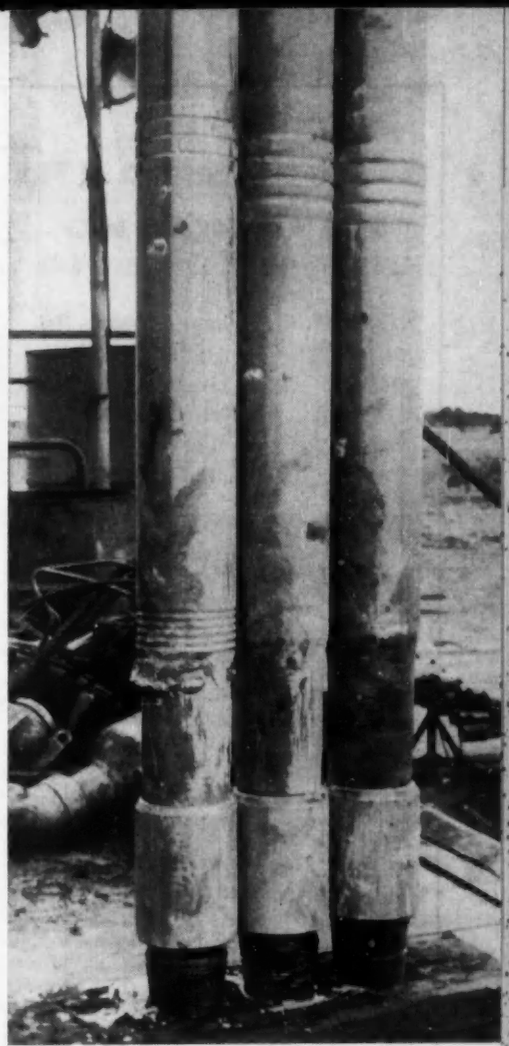
Light-weight drill pipe and tubing is experiencing its greatest gain outside the U. S., with Venezuela leading all regions. Available data, which may be somewhat incomplete, shows total footage of such pipe placed in service outside the U. S. in 1956 and 1957 and currently on order is 324,700 feet, with 196,600 feet of this amount in Venezuela and 128,100 feet in other areas.

Light-weight pipe of 4½ inches outside diameter weighs 12.75 pounds per foot for N-80 grade of pipe, and 13.75 pounds per foot for Grade E pipe. Pipe of 3½ inches diameter has a weight of 9.30 pounds per foot for N-80 grade, while Grade E in this size weighs 9.5 pounds per foot.

Fine Performance Record. Two modern strings of light-weight drill pipe equipped with special tool joints have given highly satisfactory performance in more than a year of service in Eastern Venezuela. Together they have drilled nearly half a million feet of hole, with only one minor instance of any trouble. Mene Grande Oil Company placed both of these strings in service in the spring of 1956.

One string consists of 10,500 feet of 4½-inch N-80 pipe weighing 12.75 pounds per foot. It is equipped with short length light-weight special Acme tool joint weighing but 48 pounds. Tool joints have 3 inches of hard metal on the box end, and were buckled on in the field.

This 4½-inch string drilled a total of 218,294 feet of hole in 29 wells from April, 1956 to August, 1957, when it was in service on its thirtieth hole. This string has completed wells ranging in depth from 5253 feet to 10,103 feet, with the average depth of its 29 completed wells being 7527 feet. Actual drilling time has ranged from 2.7 days for the 5253-foot well



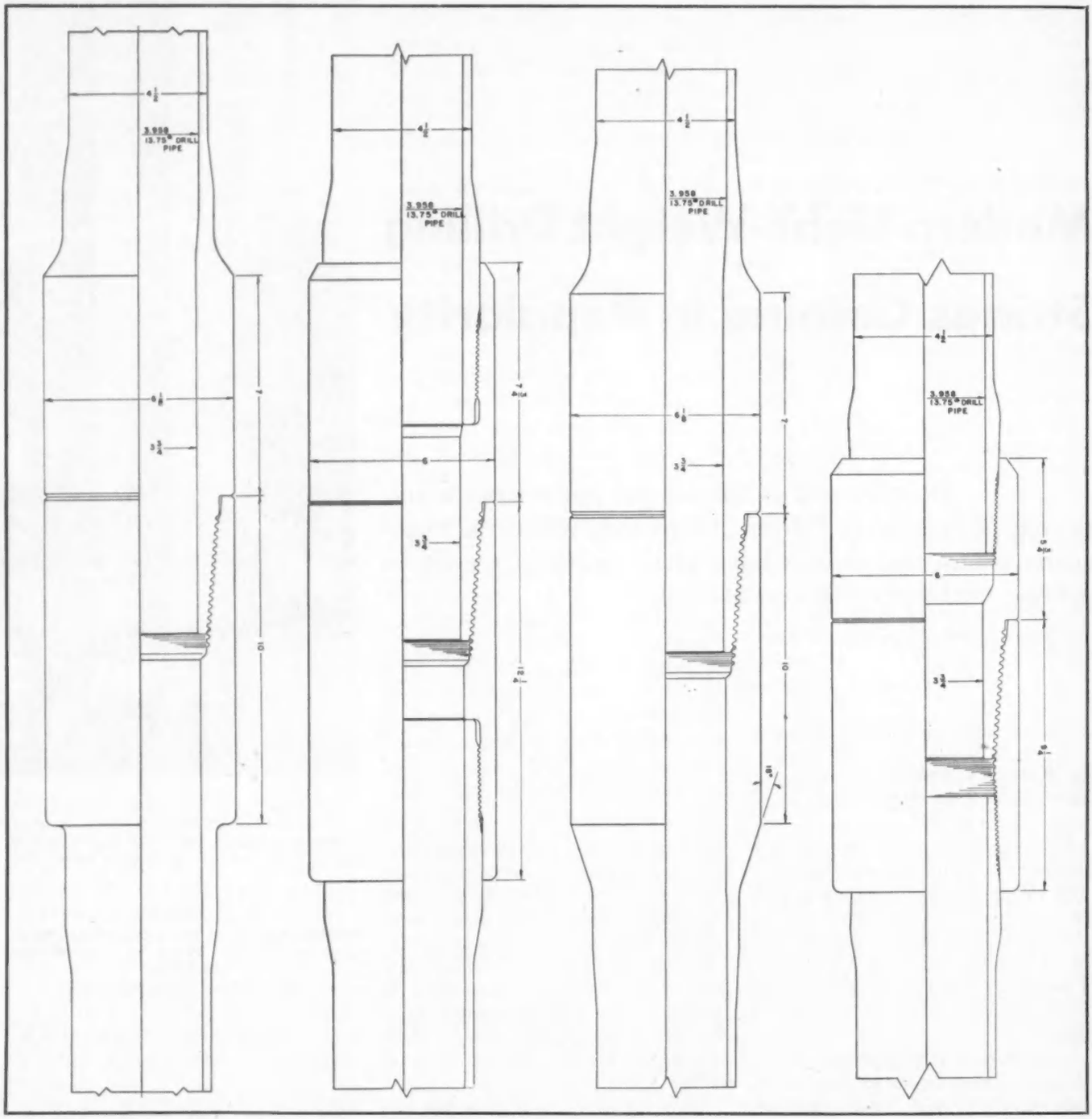
Drill collars with hard metal bands are in use on Mene Grande's 4½-inch string of light-weight drill pipe which has drilled 218,294 feet of hole in Eastern Venezuela.

TABLE 1

Drilling Record of Mene Grande Oil Company's 4½-Inch String of Light-Weight Drill Pipe

(All Wells in Eastern Venezuela)

WELL	Total Depth (Feet)	Drilling Time In Days	Gross Drilling Time In Days
No. 1	6651	5.0	6.7
No. 2	6465	4.6	13.8
No. 3	7443	5.0	11.7
No. 4	10103	10.3	20.7
No. 5	9000	6.6	15.3
No. 6	6450	2.3	8.7
No. 7	8235	5.0	9.3
No. 8	7025	3.3	10.
No. 9	7532	4.3	10.
No. 10	7673	4.5	11.3
No. 11	8627	7.0	14.7
No. 12	9395	8.4	16.
No. 13	10088	9.5	15.
No. 14	8907	8.8	18.7
No. 15	7450	5.3	11.3
No. 16	7625	4.3	11.7
No. 17	7727	5.5	10.3
No. 18	7615	4.4	8.
No. 19	8032	5.6	20.0
No. 20	7964	3.7	8.7
No. 21	5315	5.0	10.0
No. 22	5253	2.7	9.7
No. 23	7019	10.0	20.3
No. 24	7545	7.4	10.7
No. 25	7423	6.0	12.3
No. 26	6743	4.0	8.0
No. 27	5410	3.9	10.7
No. 28	6805	3.7	9.7
No. 29	6774	3.0	7.0
No. 30	Drilling	..	..
Total 29 Wells	218,294	159.1	350.3
Avge. per Well	7527	5.5	12.1



Typical 4½-inch internal flush tool joints for use with 4½-inch 13.75-pound external upset light weight drill pipe. From left to right: Square shoulder joint flash welded to pipe; a super shrink grip tool joint; an 18° elevator shoulder joint flash welded to pipe; a Pittsburgh special Acme-thread joint with short tong space.

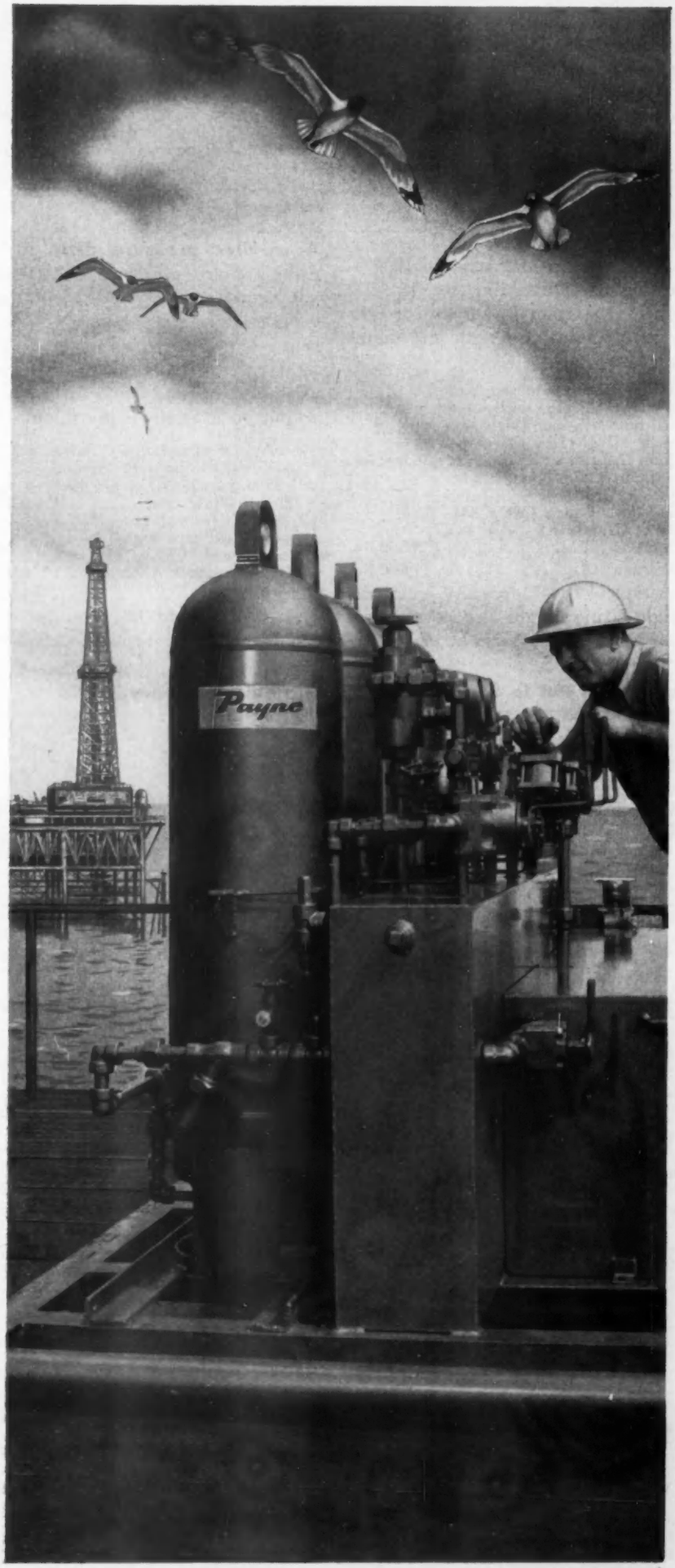
to 10.3 days for the 10,103-foot well. Total drilling time for all 29 wells has been 159.1 days, an average of 5.5 days per well. Gross drilling time from spudding to completion for the 29 wells has been 350.3 days, or an average of 12.1 days per well.

From 18 to 24 6-inch OD drill collars have been used with this 4½-inch string. The rig is powered with three 12-cylinder, 350-horsepower internal combustion engines, and is equipped with torque converter. The drawworks has six forward speeds, and two reverse speeds.

3½-Inch String Gives Good Service. The other Mene Grande string with a lengthy service record consists of 8500 feet of 3½-inch N-80 pipe weighing 9.30 pounds per foot. Tool joints on this string also have special Acme connections. Joints have only 5½ inches of tong space on the pin and but 7⅞ inches on the box. Joint weight is but 38 pounds.

Between May 5, 1956, and March 20, 1957, this string drilled 248,553 feet of hole. The only trouble experienced was the stripping of a pin above the drill collars after 200,000 feet of drilling. This resulted in 1130 feet of this string being sidetracked in the hole.

The 3½-inch drill string has drilled holes ranging in depth from 4000 feet to 8350 feet, with an average depth between 5100 and 5200 feet. The



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light weight of this string was an important factor in the successful performance of a small under-powered rig.

15 Venezuela Strings. A total of 10 strings of light-weight pipe are now in service in Venezuela, 8 of which have been delivered in the first eight months of 1957. Four additional strings are due to be in service before the end of 1957, being scheduled for shipment from the U. S. during August and September. One additional string is on order for delivery in the first quarter of 1958.

Thirteen of these 15 Venezuelan strings are 4½-inch pipe, the other two are 3½-inch pipe. Six of the 4½-inch strings are N-80 pipe, seven are Grade E pipe.

Outside of Venezuela and the U. S., three strings of light-weight pipe went into service during 1956, three additional strings so far in 1957. Two more strings are due to be shipped in 1957, and three other strings are scheduled for delivery in the first quarter of 1958.

Less weight is the chief advantage of light-weight strings. Reduced weight makes it possible to use smaller capacity rigs to reach similar depths, and is easier to handle. In addition, initial cost is less.

A typical 4½-inch modern 10,000-foot light-weight string weighs 21.0 percent less than a standard-weight string of the same length and diameter:

4½-inch 16.60-pound standard-weight drill pipe with internal flush 6⅛-inch OD x 3¾-inch ID shrink type tool joint	176,000 lbs.
4½-inch 13.75-pound light-weight drill pipe with internal flush 6-inch OD x 3¾-inch ID shrink type tool joint	139,000 lbs.
Reduction	37,000 lbs.

A typical 10,000-foot 3½-inch light weight string weighs 25.3 percent less than a standard weight string of the same length and diameter:

3½-inch 13.30-pound standard-weight drill pipe with internal flush 4¾-inch OD x 2 11/16-inch ID shrink type tool joint	135,400 lbs.
3½-inch 9.50-pound light-weight drill pipe with W.O. 4¾-inch OD x 2 15/16-inch ID shrink type tool joint	101,200 lbs.
Reduction	34,200 lbs.

A smaller pressure drop in the drilling fluid column is another advantage. Typical 10,000-foot light-weight strings experience 16.7 percent less pressure drop in the drilling fluid column on 4½-inch OD pipe, using 10½-pound mud with pump output of 500 gallons per minute:

4½-inch external upset 16.60-pound drill pipe with internal flush 6⅛-inch OD x 3¾-inch ID tool joints	1,020 psi
4½-inch external upset 13.75-pound drill pipe with internal flush 6-inch OD x 3¾-inch ID tool joints	850 psi
Difference	170 psi

A 31.9 percent less pressure drop occurs through typical 10,000-foot

TABLE 2—Light Weight Drilling Strings Put in Service in Venezuela Since January, 1956

COMPANY	PIPE				TOOL JOINT								REMARKS
	Length (Feet)	Size O.D. (Inches)	Wt. Per Foot (Lbs.)	Grade of Pipe	Size	Pipe End Connections	Working Connections	Tong Space Length Pin (Inches)	Tong Space Length Box (Inches)	O.D. (Inches)	I.D. (Inches)	Wt. (Lbs.)	
Mene Grande Oil Co.	10,500	4½	12.75	N-80	4½	Special Acme	Internal Flush	5¼	8¾	5⅞	3¾	48	3″ hard metal on box. Bucked on in fields. Drilled 218,294 ft. from April, 1956 to August 1, 1957. Square shoulder. Still in use.
Mene Grande Oil Co.	8,500	3½	9.30	N-80	3½	Special Acme	W.O.	5½	7⅞	4¾	3	38	2″ hard metal on box. Square shoulder. Bucked on in plant. Drilled 248,553 ft. from May 5, 1956 to March 20, 1957.
Mene Grande Oil Co.	12,000	4½	12.75	N-80	4½	Special Acme	Internal Flush	7½	9½	6⅛	3¾	74	3″ hard metal on box. Bucked on in plant. Square shoulder. Into service early summer 1957.
Mene Grande Oil Co.	8,600	3½	9.30	N-80	3½	Special Acme	W.O.	6⅞	9½	5	3	51	3″ hard metal on box. Bucked on in plant. Square shoulder. Into service early summer 1957.
Mene Grande Oil Co.	14,500	4½	13.75	E	4½	Shrink Grip	Internal Flush	7¾	12¼	6	3¾	70	3″ hard metal on box. Bucked on in plant. Square shoulder. Shipped from U.S. July, 1957.
Mene Grande Oil Co.	15,000	4½	12.75	N-80	4½	Flash Weld	Internal Flush	7	10	6⅛	3¾	74	3″ hard metal. 18° elevator shoulder. Recently shipped from U.S.
Mene Grande Oil Co.	15,000	4½	12.75	N-80	4½	Special Acme	Internal Flush	7	10	6⅛	3¾	74	3″ hard metal. 18° elevator shoulder. On order for 1957 delivery.
Socony Mobil Oil Co.	15,000	4½	13.75	E	4½	Flash Weld	Internal Flush	7	10	6⅛	3¾	98	18° elevator shoulder. Into service spring of 1957.
Socony Mobil Oil Co.	15,000	4½	13.75	E	4½	Flash Weld	Internal Flush	7	10	6⅛	3¾	98	Square elevator shoulder. Into service early summer, 1957.
Socony Mobil Oil Co.	12,000	4½	12.75	N-80	4½	Flash Weld	Internal Flush	5⅝	10	6	3¾	87	18° elevator shoulder. 3″ hard metal. Into service summer, 1957.
Socony Mobil Oil Co.	15,000	4½	13.75	E	4½	Flash Weld	Internal Flush	5⅝	5⅝	6⅛	3¾	90	18° elevator shoulder. 3″ hard metal. On order. Due for early shipment.
Shell de Venezuela	15,800	4½	12.75	N-80	4½	Special Acme	Acme Coupler	....	7⅜	5 9/16	3 15/16	13.31	427 joints without hard metal bucked on in plant. 100 joints with 1½″ hard metal bucked on in field. Into service early 1957.
Creole Petroleum Co.	15,000	4½	13.75	E	4½	Shrink Grip	Internal Flush	7¼	12	5⅞	3¾	59	3″ hard metal. Square shoulder. Bucked on in plant. Due for early shipment.
Perforaciones Y Servicious	14,200	4½	13.75	E	4½	Shrink Grip	Internal Flush	7¾	12¼	6	3¾	70	Square shoulder. Into service early summer 1957.
STOCA	10,500	4½	13.75	E	4½	Shrink Grip	Internal Flush	7¼	12	6	3¾	70	3″ hard metal. Bucked on in plant. Square shoulder. Delivery due 1st quarter 1958.
Total Footage	196,600	....	....	....	....	.....	.....	....	....	....	....	..	.....

TABLE 3—Light Weight Drilling Strings Put in Service Since January, 1956, in Areas Outside United States and Venezuela

PIPE				TOOL JOINT								
							Tong Space Length					
Length (Feet)	Size O.D. (Inches)	Weight Per Foot (Lbs.)	Grade of Pipe	Size	Pipe End Connections	Working Connections	Pin (Inches)	Box (Inches)	O.D. (Inches)	I.D. (Inches)	Wt. (Lbs.)	REMARKS
12,600	4½	13.75	E	4½	Shrink Grip	Internal Flush	7¼	12	5⅞	3¾	59	Square shoulder. In service in Colombia, spring, 1957.
8,000	3½	9.30	N-80	3½	Flash Weld	W.O.	7	9½	4¾	3	55	18° Elevator shoulder. In service July, 1957.
11,300	4½	12.75	N-80	4½	Special Acme	Internal Flush	6½	9½	6⅛	3¾	67	Square shoulder. Recently put in service in Australia.
12,600	3½	9.30	N-80	3½	Special Acme	Extra Hole	6½	9½	4½	2 7/16	40	Square shoulder. To be delivered soon for Australian service.
12,000	4½	12.75	N-80	4½	Special Acme	Internal Flush	6½	10	6⅛	2 7/16	75	1½-inch hard metal. Bucked on in field. Shipped early 1956 for Portugal service.
14,000	3½	9.30	N-80	3½	Special Acme	Extra Hole	6½	9½	4½	2 7/16	40	Square shoulder. Bucked on in plant. Shipped early 1956 for Australian service.
600	4½	12.75	N-80	4½	Special Acme	Internal Flush	5¼	8¾	5⅞	3¾	48	Square shoulder. Bucked on in field. Shipped early 1956 for Portugal service.
25,300	4½	13.75	E	4½	Flash Weld	Internal Flush	7	10	6¼	3¾	80	3-inches hard metal. On order for first quarter 1958 delivery for Indonesia service.
12,700	3½	9.5	E	3½	Flash Weld	Internal Flush	7	9½	4¾	2 11/16	60	3 inches hard metal. On order for first quarter 1958 delivery for Indonesia service.
11,000	4½	13.75	E	4	Flash Weld	Full Hole	7	10	5½	2 13/16	90	Square shoulder. 2 inches hard metal. On order for late 1957 delivery for Netherlands service.
8,000	4½	13.75	E	4½	Flash Weld	Slim Hole	7	10	5	2 11/16	84	No shoulder. 3 inches hard metal. On order for first quarter delivery 1958 for Trinidad service.
128,000	...	....	....	...	.....	.....	....	....	....	....	..	.....

strings of light-weight 3½-inch drill pipe, when using 10.5-pound mud with pump output reduced to 275 gallons per minute:

3½-inch external upset 13.30-pound standard-weight drill pipe with internal flush 4¾-inch OD x 2 11/16-inch ID tool joints	1,600 psi
3½-inch external upset 9.50-pound light-weight drill pipe with W.O. 4¾-inch OD x 2 15/16-inch ID tool joint	1,090 psi
Difference	510 psi

Tool Joint Advancements. The first light-weight strings of drill pipe went into service around 1950, using standard casing and tubing couplers. As the light-weight strings were extended the standard couplers began giving the same trouble that was encountered when couplers were first used on standard-weight drill pipe before tool joints were developed. This trouble consisted of frequent last engaged thread failures, creepage of the coupler, split couplers due to creepage, and thread wear.

The demand for light-weight tool joints at an acceptable price became more apparent, resulting in the Pittsburgh special Acme thread coupler coming into use. This coupler had a counterbore that sealed on a land behind the threads, which helped to prevent some of the thread failures but did not reduce any of the other disadvantages.

The next step was to manufacture these special Acme thread couplers from alloy steel material. The alloy steel couplers out-performed the standard tubing couplers by a 10-to-1 ratio, but thread wear was still excessive on the working connections.

The improved service obtained with alloy steel couplers caused users to realize the advantages that might be obtained from specially designed light-weight tool joints. This realization lead to a continuous development of many special tool joints.

At first the trend in designing special light-weight tool joints was to keep them as small as possible in both diameter and length, but with maximum bore. The result was tool joints for 4½-inch pipe that were less than 6 inches in outside diameter, and 4¾-inch OD joints for 3½-inch pipe. Some of these joints provided tong space of but 5 inches on the pin and around 7½ inches on the box. Weight of some of the 4½-inch tool joints was less than 50 pounds, while joints for 3½-inch pipe weighed less than 40 pounds.

The improved performance attained with the above described tool joints is responsible for the present tendency to order tool joints with larger outside diameters and standard length tong space. (See Tables 2 and 3).

Most of the tool joints for 4½-inch light-weight pipe that have been delivered in 1957 or are currently on order have 6-inch or 6½-inch outside diameters, while retaining the 3¾-inch inside diameter. These joints provide additional metal as protection against wear. In addition, many of the recently ordered joints have 3 inches of hard metal on the box end.

Most of the recently ordered 4½-inch tool joints have tong space of 7 inches on the pin end, although some have more and some have less length. Tong space on the box end has been increased to 9½ inches, 10 inches and even 12 or more inches. These specifications, coupled with the increased metal provided by larger outside diameter joints, should result in even better light-weight drill pipe performance in the future —**The End**

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Recent Developments in Hydraulic Fracturing

A combination of the correct fracturing techniques and materials may eventually solve fracturing problems.

By E. J. Coel, Jr.
El Paso Natural Gas Company
Farmington, N. M.

SINCE THE inception of hydraulic fracturing a great number of the original theories and methods have been cast aside or improved upon through research and field experimentations.

SOME OF THE original concepts that have undergone some change are:

1. A viscous fluid was required to cause parting.
2. A propping agent should be carried in suspension.
3. An oily base fluid was required.

Some others that have undergone little change are:

1. The fracturing fluid must be thin enough to return to the well bore.
2. Sufficient pump capacity must be maintained to inject fluid faster than its formation leakage. This last precept has been altered somewhat by the use of suspended solid particles that act as temporary plugs of capillary porosity in the formations.

The original idea of fracturing with fluid has lent itself to a variety of tailor made fluids, each designated to conform to specific situations and formations.

Currently, the addition of an oil soluble soap to kerosine, diesel oil or lease crude, to form a gel-like fluid is used in only 6 percent of the wells fractured. This method is used mainly in Illinois, Kentucky, Ohio and Pennsylvania in the low temperature, low pressure formations present there. The fracturing fluid viscosity must be reduced by the further addition of a gel-breaker compound.

A combination of acidizing and fracturing for limestone and calcareous type formations is used about 2 percent of the time. This fluid, primarily a water in oil emulsion of acid and kerosine or diesel oil, has the advantage of delayed chemical action which also accounts for the reduction of fluid viscosity for flowing back. This use is widespread and has been used on the Gulf Coast in some sandstones.

Still another fluid is an oil in water emulsion. Its main application is found in Northern Louisiana and Southwest Texas, Cretaceous sands accounting for 2 percent of the wells fractured. It is a particularly difficult type of fluid to handle, being a mixture of water, oil, chemical breaker and emulsifier. Advantages are slow pumpability and carrying ability of up to ten pounds of sand per gallon.

One gel-type fluid made from mono basic soap and crude oil uses formation oil as the breaking agent. Extended use has been found for this gel type in all known oil producing formations from Pennsylvania to the Gulf Coast. Its chief advantages are ready preparation in the field and fast viscosity breakback in the formation, therefore lending its sand carrying qualities to zones not easily fractured.

Sixty-eight percent of all fracturing work is done using a simple mixture of refined or lease crude and sand. All types of formations have been treated with this mixture. Its popularity extends mostly to oil sands, however, gas sands have been treated and are known to respond favorably to this method. Modifications of this treatment are readily available using any of the previously mentioned types of additions. However, a rapid pumping rate is desired at all times for the prevention of sand fallout.

Newest Type of Fluid. Although only 5 percent of the wells fractured during 1956, used sand and water, this process is growing in popularity. Incorporating the same principles as oil and sand; water and sand with the addition of chemicals can control bentonitic swelling and emulsions. This method was first introduced in the San Juan Basin for treatment of low pressure, low permeable gas producing sandstones.[2] Recently it has spread to the dolomites of West Texas and Oklahoma and to sandstones of Pennsylvania and Ohio.

The advantages of a water-sand mixture are numerous:

1. It is a safe mixture; no fires have resulted due to broken lines or valve leaks.
2. It is inexpensive; costing only the transportation to the well site and the storage there.
3. The sand carrying characteristics are nearly as good as those of refined oils.
4. Water is an adaptable fluid for addition of emulsion breakers, gelling agents, acid and other chemicals.

Still another advantage is its ability to dissolve salt, a major factor in the fracturing of some sandstone. In the San Juan Basin the chloride content of the water increases from 100

ppm before fracturing to an average of 6000 ppm on its return from the formation. Some operators regard this as especially significant and have discontinued the use of sand altogether.

Disadvantages of water-mixtures are their ability to swell shales encountered and to form emulsions with oils encountered in the formation. In several cases it has been noted that injected water in oil wells is recovered at slow rates after its initial flow back.

However, untreated water and sand have been used to fracture oil wells with good results in the Rangely and Sprayberry fields with increases in production being similar to those obtained by oil-sand mixtures.

The properties of the oil and the lithology of the formation should indicate the proper additives required to make water a universal fluid in hydraulic fracturing.

Large Treatments and Injection Rates. The types of fracturing fluids and the chemical additives required show why original fractures were expensive. Theoretically the fracture radius is proportional to the injection rate and to a lesser degree proportional to the viscosity and volume of fluid used. To reduce expenses of the fluid type fracturing and increase or maintain the radius of fracture, only the injection rate and the quantity had to be increased.

The sand-in-oil and sand-in-water processes were evolved from this. Almost without exception the gel-type fluids are pumped at relatively slow injection rates through drill pipe or tubing. Gel-type fluids are designed to carry sand in suspension at these slow rates, usually from one to six barrels per minute. The expenses of fluid, packers, and rig time made large treatments prohibitive. By fracturing down the casing, or tubing and casing, higher injection rates are obtained. Consequently, less costly fluid types can be used. An attempt to extend fractures and produce all the sand in the well spacing has brought about larger and longer treatments. Gel-type fluids usually account for volumes of 2000 to 10,000 gallons per treatment. A recent Sprayberry sand well in West Texas, treated with 250,000 gallons of water, reflected a larger trend yet than the average 50,000 to 75,000 gallon treatment of oil or water. Injection rates are also climbing with the advent of larger high pressure pumping equipment used down the casing. Such rates have increased from about 20 to 95 barrels per minute.

Sealing Agents. Naphtha balls, walnut hulls, lost circulation material, heavy mud, etc., have all been used to create temporary seals across the face of formations to isolate zones of productivity during fracturing. All have had varying degrees of success both in open hole and perforated casing. They have played a part in both multi-zone fracturing and vertical fracturing (the creation of a vertical fracture that crosses impermeable barriers to assure all zone fracturing). The alternative was the use of bridging plugs to isolate larger zones and fracture in several stages.

By casing and cementing the pay section and perforating the desired intervals, a different more positive method of selectivity was introduced. The ball sealer is a ball made of rubber, plastic, neoprene, etc., that will seal a perforation against a differential pressure without passing through the hole and yet drop away when the differential pressure is higher on the formation side.

The ball seal has been used to eliminate a bridging plug, thereby providing a positive method of multi-zone fracturing under a continuous operation. It does not cover all cases; however, it is finding universal acceptance.

The balls are usually $\frac{7}{8}$ or $\frac{15}{16}$ inches in diameter and have been tested to withstand 10,000 psi differential pressure without passing through $\frac{1}{2}$" perforations. Various methods of placement have been used in experimentation. Balls have been injected individually to seal each perforation or in batches to seal a series of perforations, in order to breakdown a zone more resistant to fracturing pressures than the previous zone. Recently R. W. Coburn[3] presented a method of batching or staging a multi-zone treatment based on a known injection rate, number of perforations (of a known size, in this case $\frac{3}{8}$" diameter), and maximum rate of fluid that can be pumped through a perforation of the this size. The formulae are as follows:

$$\text{No. of stages} = \frac{1.3 \text{ bbls per min.} \times \text{No. of } \frac{3}{8}\text{" holes}}{\text{Injection rate to be used}}$$

$$\text{No. of ball sealer per stage} = \frac{\text{Injection rate to be used}}{1.3 \text{ bbls. per min.}} \times 1.2 \text{ (extra balls)}$$

The recent success of ball sealers in fracturing new wells has led to better workover and refracturing results in old wells.

Storage Methods. Larger treatments with oil and water have introduced a problem of liquid storage capacity at the well. Smaller treatments could be handled by rig tanks, one or two trucks, or skid mounted steel tanks. The initial cost, hauling charges, and recent steel shortages have brought about substitute materials for storage.

Collapsible rubber tanks were introduced last year. Several tanks could be hauled on one truck and inflated at the location by filling with oil or water. As liquid metering devices are not in common use, rubber tanks do not allow a ready method of controlling staged amounts of fluid because they collapse as the liquid is withdrawn.

Vinyl plastic liners are being used to prevent liquid loss in earthen tanks. Some grades of vinyl, though fairly expensive, may be used several times providing a cheaper container for storage than steel tanks.

A canvas tank mounted on light metal brackets can hold up to 100,000 gallons. The canvas is treated with rubber or plastic impregnation and is hauled in a folded position. Low hauling and maintenance costs make this a most adaptable storage for larger treatments.

San Juan Basin Illustrations. For a better understanding of recent fracturing developments and the results obtained, the San Juan Basin of New Mexico has been selected as an illustration. The Basin's development has undergone a complete revolution of fracturing techniques both in gas and oil sands of Cretaecous age. Over 1000 wells in this area have been stimulated by fracturing.

Shallow Gas Zones. In 1952, several gel-type fluids were used to fracture the Pictured Cliffs sandstone wells. This pay is 2000 to 3000 feet in depth with low reservoir pressure, (600

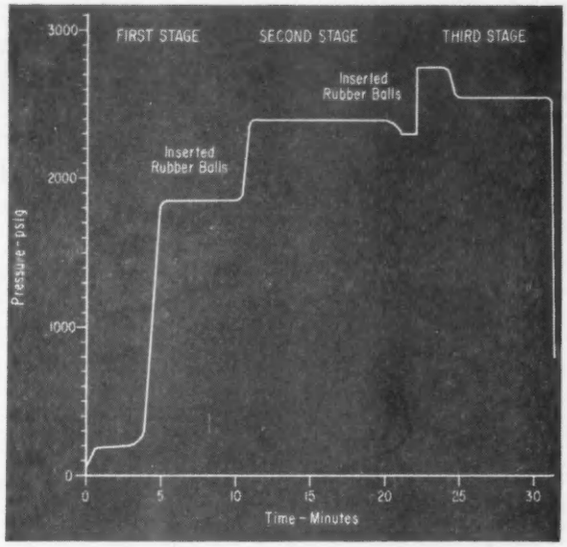

FIGURE 1—Showing effects of rubber balls on shallow well fracturing, all perforations fractured.

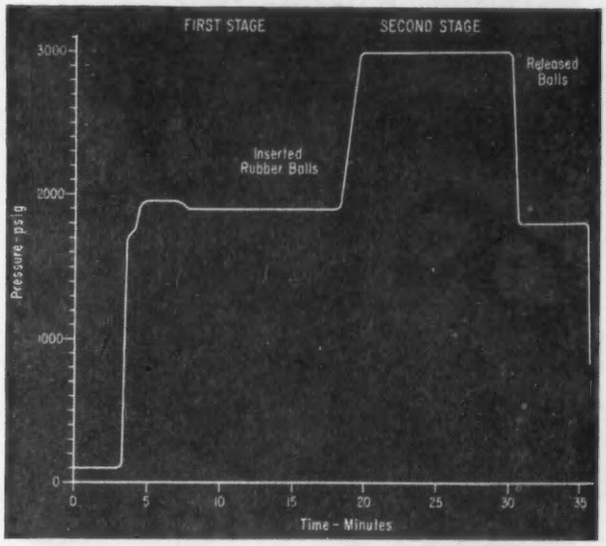

FIGURE 2—Showing effects of rubber balls on shallow well fracturing, only a portion of perforation fractured.

psig.). The gel-type liquids were used in quantities of 2000 gallons and failed to increase the productivity of the wells sufficiently over what was being accomplished by shooting with explosives. Core analysis of shot holes indicated a maximum of six feet fracture penetration from shooting.

Sand and oil were still being used in 1953 in small quantities of 2000 to 4000 gallons per treatment. These treatments provided calculated fractures radii up to 72 feet in length. This type treatment was performed through tubing and packers with the gas pay exposed as open hole below production casing.

After water was introduced in 1955, the completion program was modified to case through the pay, perforate and fracture down the casing with large volumes. At present the average treatment includes 30,000 to 40,000 gallons of water and one to one and one-half pounds of coarse grained sand per gallon.

Sand in larger quantities has been experimented with in the low pressure zone because of its ease in accepting high injection rates, about 60 to 80 barrels per minute. Although no sand-outs have occurred, the results indicated only a larger amount of sand return and not a larger productivity.

In April of this year an attempt was made to fracture such a well with water only. Log interpretation indicated a section thickness of 90 feet, past performance in this area has shown wells of unusual productive ability ranging from 10 to 20 million cubic feet per day after fracture. However, flow back of sand laden gas causes dangerous conditions at this rate by eroding well head valves. To eliminate this condition only water was used to create the necessary fractures. Thirty-four feet of sand section was perforated and treated with 54,600 gallons of fresh water, at a rate of 65 bbls/min, treating pressures were 1500 psig. Initial potential after the first treatment was 174 Mcf/D. The well was refractured using 40,000 gallons of water, 40,000 pounds of sand, injection rate 65.2 bbls/min., treating pressures 1500 psig. New potential recorded was 17,000 Mcf/D.

On wells in which the pay zone is broken by shales instead of a solid zone as above, rubber balls have aided successful fracturing of two or three sand sections. Figure 1 illustrates a three stage fracturing treatment in which 46 rubber balls were dropped twice while pumping 40,000 gallons of water and 40,000 pounds of sand through 112 perforations at 49 barrels per minute. This might be termed a near perfect fracture treatment indicating that the performance figures show three distinctly different treating pressures with the insertion of rubber balls.

Figure 2 indicates a similar situation in which 55 rubber balls were dropped only once during a treatment of 53,288 gallons and 40,000 pounds of sand injected through 120 holes at 46.5 barrels per minute. As shown on chart, the second stage indicated an increase in pressure to 3000 psig. Apparently enough holes would not breakdown to continue the treatment without danger of a sand-out. The pumping pressure was released and the balls dropped off, as shown by the final treating pressure which approximated the first stage pressures. Originally this treatment had been scheduled for three stages.

In this formation bentonitic control, while using water, has been considered. Two wells were fractured with the addition of 1 percent by weight of calcium chloride to water. By comparison to fractured offsetting wells the increase in productivity was small, indicating high injection rates and rapid removal of water resulted in little or no effect on the bentonites present (about 12 percent).

Since these wells are mud drilled, in many cases, mud acid must be placed ahead of the fracturing fluid to assure ease in breaking through the mud and cement cake. In most cases where acid is used in this manner breakdown pressures are two to three hundred pounds lower and injection rates 5 to 10 barrels per minute higher.

Medium Depth Gas Wells. The Mesa Verde sands at 4500 feet to 6000 feet have been especially receptive to oil and water fracturing processes. Like the Pictured Cliffs sands these are also sands of low permeability, low pressure (BHP average 1300 psig), low porosity (8 percent to 12 percent). The development of the oil-sand method brought fracturing techniques to the Mesa Verde

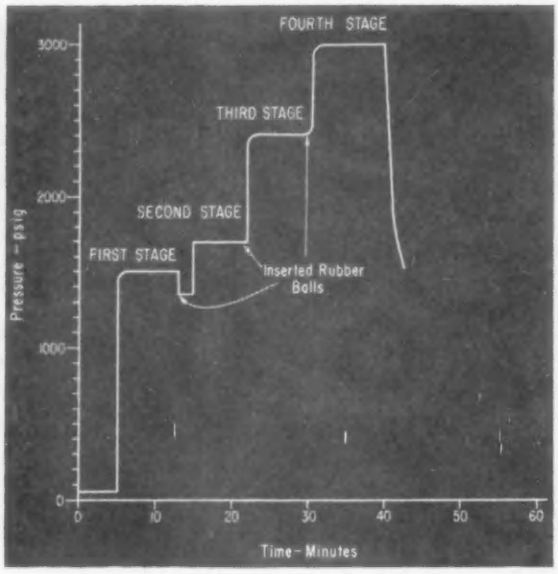

FIGURE 3—Showing effects of rubber balls on medium depth well fracturing all perforations fractured.

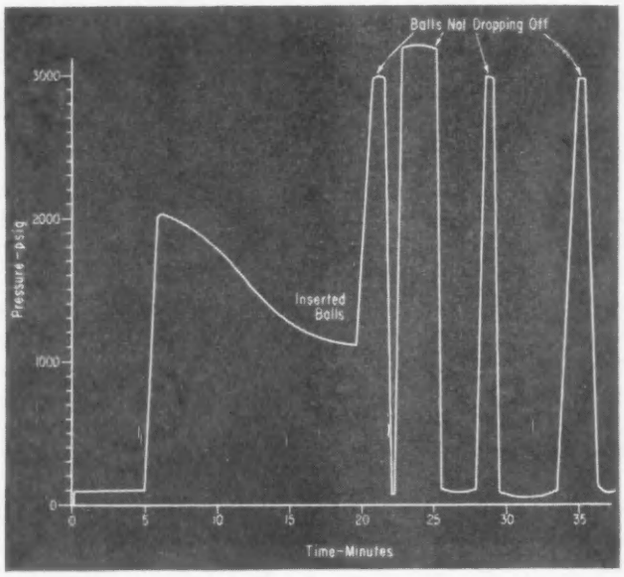

FIGURE 4—Showing effects of rubber balls on medium depth well fracturing only a portion of perforation fractured.

open hole sections. Fracturing was through packers set in the open hole to divide the various sands.

When a method was devised to case off the open gas drilled holes, water was used instead of oil. The additional weight of water allowed lower breakdown pressure and faster injection rates and easily overcame the lesser sand carrying ability of this less viscous liquid. An immediate advantage was realized on the first treatment, using water as a fracturing medium, when a broken connection under the rig floor, sprayed water, sand and gas back under the motor with no fire resulting.

Fracturing pressures are relatively low usually in the range of 1500 psig to 2500 psig, with injection rates 45 barrels per minute at higher pressures to 98 barrels per minute at 1000 psig. A conclusion may be drawn that very few new fractures are created in this type formation but the fracturing technique serves to open wider and scour natural fissures and shale-sand interfaces found in them. Some operators have taken[4] advantage of the high chloride content found in these sands and depend upon water without sand to increase the productivity. Many wells treated without sand seem to produce very well. Several instances have occurred, however for example the Pictured Cliffs well previously sited, which showed increases in productivity when retreated with sand in water.

Figure 3 shows the separation of a treatment using rubber balls in which 46 balls were dropped three times while pumping 59,900 gallons of water and 50,000 pounds of sand at 54.5 barrels per minute through 176 holes.

Figure 4 shows complete breakdown in a very tight section was not accomplished. Two stages were planned but only one was accomplished as the balls blocked the open perforations and the others did not breakdown; subsequently, causing a cleanout before refracturing.

In fracturing perforations several hundred feet apart this technique has not been sufficiently developed; it is necessary to set bridging plugs to separate zones at these intervals.

Deep Gas Zones. Very few wells have been successfully fractured in the Dakota formation found between 7900 feet and 8300 feet. This is probably due to the compaction and tightness of this sand and the greater pressures required to break into it.

One well, apparently with natural fissures, was perforated and fractured with 17,500 pounds of sand and 20,100 gallons of oil; injection rate was 53 barrels per minute at 3000 psig. The well flowed 486 Mcf/d naturally and increased to 5060 Mcf/d after treatment. However, an offset well producing about 200 Mcf/d responded to a similar treatment by increasing the productivity to only 734 Mcf/d. Most Dakota wells have reacted similar to this, although several types of gel fluids and water treatments have been attempted.

This phenomena is not confined to the San Juan Basin. Many instances throughout the country have shown that very few wells are successfully fractured below 8000 feet in depth. Fracture treatments have been attempted at depths down to 15,000 feet with pumping pressures up to 8000 psig at the wellhead. Increase in production averaged less than 1000 Mcf/d—not a significant amount for wells of this depth and expenses involved.

These developments in fracturing techniques and materials are not the ultimate goals. A series of combinations using several methods at a time may answer many problems not previously solved; however, the advent of new mechanical tools and new technical ideas together will bring about the eventual solution that we all seek.

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ACKNOWLEDGMENT

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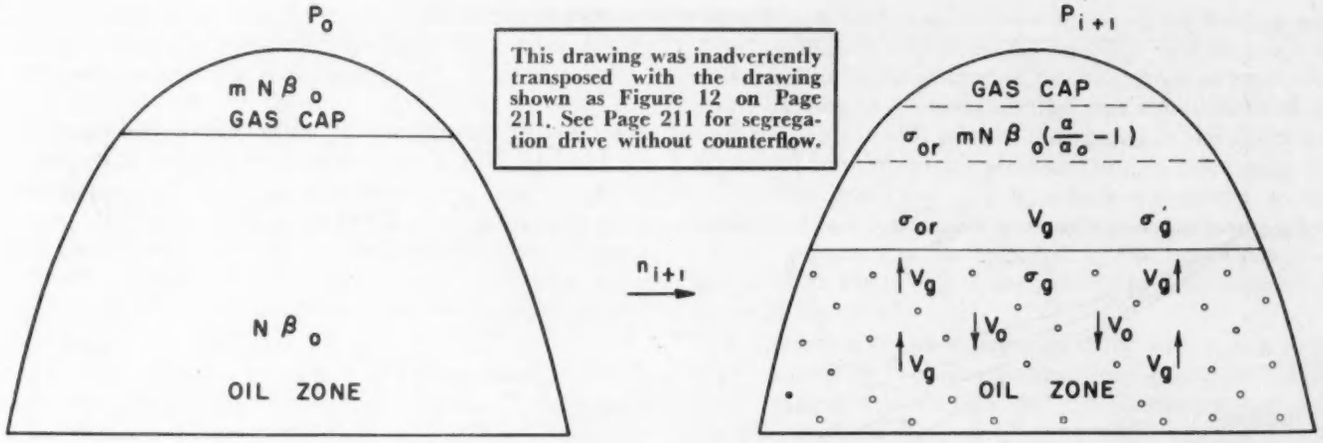

This drawing was inadvertently transposed with the drawing shown as Figure 12 on Page 211. See Page 211 for segregation drive without counterflow.

FIGURE 10—Segregation drive without counterflow: a process of oil recovery in which oil is displaced downstructure by a naturally expanding gas-cap or by an artificially expanding gas-cap as a result of gas injection at structurally high wells.

Part 2–Production of Oil by Segregation Drive and Combination Drive

A Universal Theory of Oil Reservoir Engineering

When segregation drive in an oil field can be promoted, either with or without gas and oil counterflow, oil recoveries may become extremely high.

By Dr. S. J. Pirson
The University of Texas
Austin

THE COMBINATION depletion-segregation drive is one in which both depletion and frontal displacement of oil by gas drive take place simultaneously.

Two types of segregation drives are possible: one where the frontal gas drive is by a naturally or artificially expanding gas-cap and without gas and oil counterflow; in the other the expansion of the gas-cap results altogether from counterflow of gas and oil within the oil zone under the influence of gravity.

Segregation Drive Without Counterflow. (Figure 10) The performance and recovery by gas-cap expansion without counterflow of oil and gas in the oil zone may be solved by means of modified equations of depletion drive.

A pre-existing gas-cap expanding naturally because of field pressure decline may provide the frontal drive or an artificial gas-cap may be induced by injecting a certain fraction (I) of the produced gas at structurally high positions or into a pre-existing gas-cap. Gas injection in effect precludes the occurrence of gas and oil counterflow in the oil column since the injection pressure reverses the vertical gas flow potential gradient necessary for its movement by buoyancy to the gas-cap.

The simultaneous equations which describe this process on a finite difference basis are as follows:

$$\Delta_i^{i+1}n = \frac{(1-n_i)\,\Delta_i^{i+1}\left(\frac{\beta}{\alpha}-S\right) - (1+m)\,\beta_o\,\Delta_i^{i+1}\frac{1}{\alpha}}{\left(\frac{\beta}{\alpha}-S\right)_{i+1} + (1-I)\,R_{av}}$$

$$R = S + \frac{\beta}{\alpha}\cdot\frac{k_g}{k_o}\cdot\frac{\mu_o}{\mu_g} \qquad (10)$$

$$\sigma_1 = \sigma_w + (1-\sigma_w)\frac{(1-n)\,\beta}{\beta_o}$$

in which m is the original gas-cap volume relative to the original oil zone volume and I is the injected fraction of the produced gas.

The injection ratio necessary to maintain a certain pressure or to operate a partial pressure maintenance is:

$$I = 1 + \frac{(\beta/\alpha - S)}{R}$$

Since pressure is maintained, no subscripts are needed to the various functions. It is noted that the gas injection requirement to maintain pressure is independent of the field producing rate.

The injection ratio necessary to maintain the field at the bubble-point pressure through gas-cap injection is given by $I = \frac{\beta_o}{\alpha_o S_o}$.

The driving indices on a finite basis of this combination drive process are:

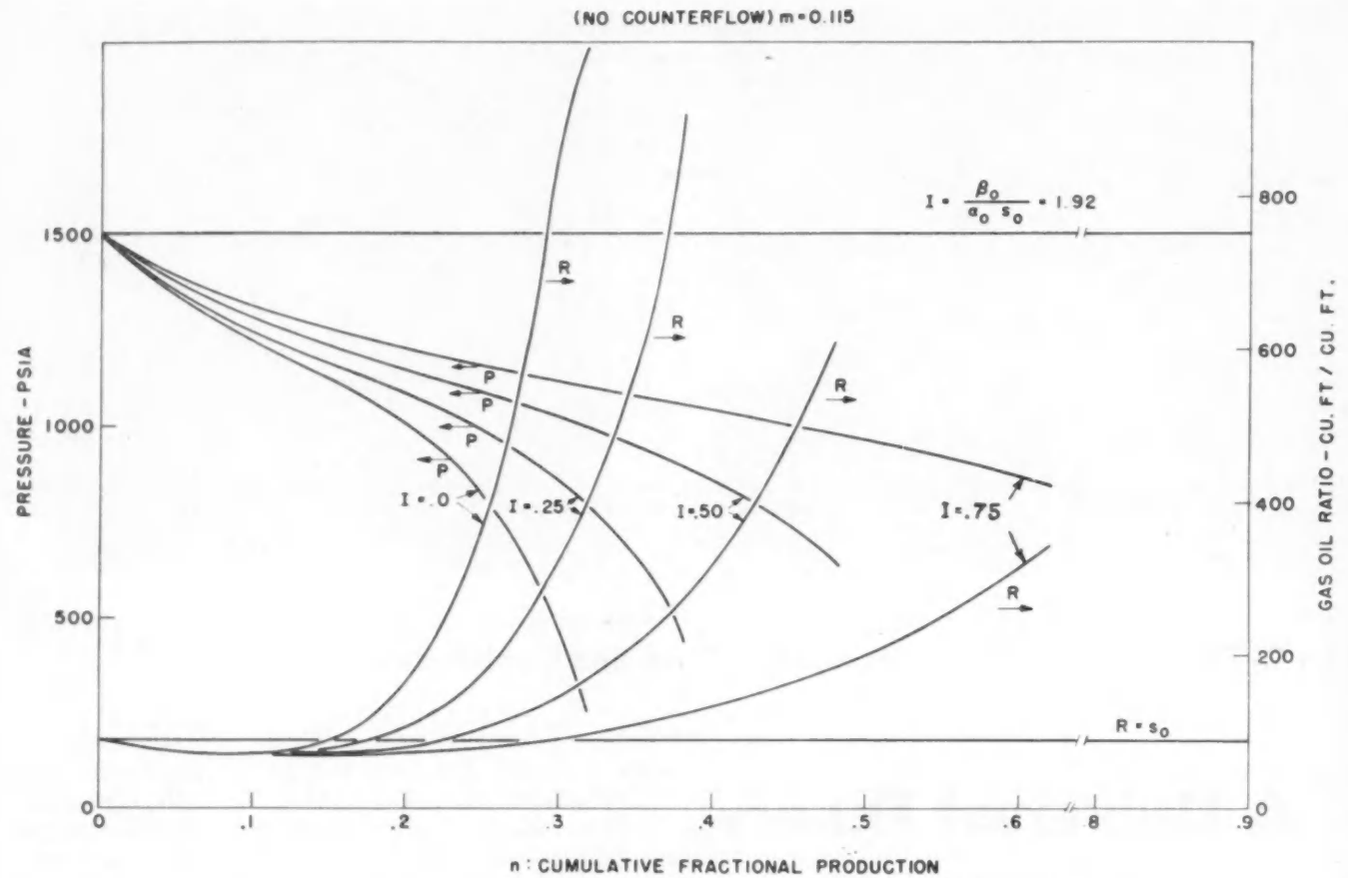

FIGURE 11—Segregation drive performance in the reservoir of Figure 2 (Part 1) in which a pre-existing gas-cap was assumed but where its expansion also occurs by injecting gas in it according to various fractions I of the total produced gas.

Depletion Drive Index:

$$DDI = \frac{N\left[\left(\frac{\beta}{\alpha} - S\right) - \left(\frac{\beta_o}{\alpha} - S_o\right)\right] - GI}{n\left(\frac{\beta}{\alpha} - S\right) + G} \qquad (11)$$

Segregation Drive Index: $SDI = \dfrac{mN\beta_o\left(\frac{1}{\alpha_o} - \frac{1}{\alpha}\right) + GI}{n\left(\frac{\beta}{\alpha} - S\right) + G}$

The driving indices on a differential basis are given by:

$$DDI = \frac{(1 - n_i)\,\Delta_i^{i+1}\left(\frac{\beta}{\alpha} - S\right) - \beta_o\,\Delta_i^{i+1}\frac{1}{\alpha}}{\Delta_i^{i+1} n\left[\left(\frac{\beta}{\alpha} - S\right)_{i+1} + R_{sv}\right]} \qquad (12)$$

$$SDI = \frac{-m\beta_o\,\Delta_i^{i+1}\left(\frac{1}{\alpha}\right) + \Delta_i^{i+1} n \cdot R_{sv} \cdot I}{\Delta_i^{i+1} n\left[\left(\frac{\beta}{\alpha} - S\right)_{i+1} + R_{sv}\right]}$$

Performance curves of the field of Figure 2 under various assumptions of gas injection in a pre-existing gas-cap are given in Figure 11.

Overall recovery by both processes for a combination depletion-segregation drive reservoir is a function of the degree of effectiveness of each process, i.e., of their respective driving indices, but also of the rate of advance of the expanding gas-cap front for the displacement efficiency of a frontal gas drive is rate sensitive. This displacement efficiency calculation should therefore be made at each pressure decrement. The overall recovery (r) by both processes may then be computed from:

$$r = \sum_{o}^{i+1} \left\{ (DDI)\, r_d + (SDI)\, r_s \right\} \qquad (13)$$

where r_s is the recovery by segregation drive at a specific step. The driving indices and the recovery factors are written for a specific pressure decrement and the summation extends over the duration of the operation until ultimate abandonment pressure P_{i+1} is reached. This abandonment pressure is determined by reservoir fillup, i.e., when the gas front has expanded to the producing wells.

This oil recovery process does not appear to possess a well-defined physical MER at which recovery will be maximum unless it be at the original bubble-point pressure because no dispersed gas phase develops then, and no tendency for gas diffusion into the oil zone exists. Although the displacement efficiency is affected by rate of withdrawal, when the economic MER is considered, additional increased physical efficiency seems to be a minor

consideration in view of the major purchasing gas requirements needed to maintain the high field pressures in bubble-point pressure maintenance.

Segregation Drive With Counterflow. (Figure 12) Segregation drive with counterflow is the oil recovery process whereby oil is expulsed from its rock container by the expansion of a naturally developing gas-cap generated by the accumulation of gas flowing upward through the oil column under the action of the buoyancy force existing between two fluids of different density, namely, reservoir oil and gas.

For this process to operate, a gas phase must be developed and maintained within the oil column in order that gas permeability may exist for its upward flow. This gas phase is produced by simple depletion, which process must first exist alone before segregation drive may take over later. No gas-cap injection may take place; otherwise active segregation would be prevented. The equations of depletion drive will therefore control the process in the early stage of operation. An original gas-cap may exist at the start, and the performance equations that describe this process are written as follows on a finite difference basis:

$$\overset{i+1}{\Delta_1 n} = \frac{(1-n_1)\,\overset{i+1}{\Delta_1}\left(\frac{\beta}{\alpha}-S\right) - (1+m)\,\beta_o\,\overset{i+1}{\Delta_1}\frac{1}{\alpha}}{\left(\frac{\beta}{\alpha}-S\right)_{i+1} + R_{av}}$$

$$R = S + \frac{\beta}{\alpha}\cdot\frac{k_g}{k_o}\cdot\frac{\mu_o}{\mu_g}$$

$$\sigma_1 = \sigma_w + (1-\sigma_w)\,\frac{(1-n)\,\beta - \left[\frac{V_g}{N} + m\beta_o\left(\frac{\alpha}{\alpha_o}-1\right)\right]\frac{\sigma_{or}}{\sigma_g'}}{\beta_o - \left[\frac{V_g}{N} + m\beta_o\left(\frac{\alpha}{\alpha_o}-1\right)\right]\frac{1}{\sigma_g'}} \qquad (14)$$

$$\overset{i+1}{\Delta_1} V_g = A\left[\frac{K_g}{\mu_g}\text{ or }\frac{K_o}{\mu_o}\right]\frac{\Delta\vartheta\sin\alpha}{1033}\cdot\overset{i+1}{\Delta_1}\theta$$

$$nr_r = S_o - (1-n)\,S - \frac{1}{\alpha}\left[\frac{V_g}{N} + \frac{\sigma_g}{\sigma_g'}\left\{\beta_o\,\sigma_g' - \left[\frac{V_g}{N} + m\beta_o\left(\frac{\alpha}{\alpha_o}-1\right)\right]\right\}\right]$$

In the process of active reservoir oil and gas segregation, overall field pressure no longer controls fluid saturation distribution within the oil zone and it is necessary to calculate the liquid saturation resulting from oil replenishment because of gravity drainage and counterflow of oil and gas. This modification is introduced in the saturation equation. Solution to this problem requires calculating the volumetric segregated gas V_g which contributes to the expansion of the gas-cap. For verification purposes, a gas balance equation is also introduced. The performance of the field of Figure 12 under active segregation drive is given in Figure 13.

A characteristic of segregation drive with counterflow is the constantly declining pressure and gas-oil ratio (the latter being always less than the original solution gas) and the very high oil recovery. It is naturally postulated that all the producing oil wells are completed within the oil column and the flowing gas-oil ratio is determined by the prevailing fluid saturation therein.

The driving indices on a finite basis are written:

$$DDI = \frac{N\left[\left(\frac{\beta}{\alpha}-S\right)-\left(\frac{\beta_o}{\alpha}-S_o\right)\right]-\frac{V_g}{\alpha}}{n\left(\frac{\beta}{\alpha}-S\right)+G}$$

$$SDI = \frac{mN\beta_o\left(\frac{1}{\alpha_o}-\frac{1}{\alpha}\right)+\frac{V_g}{\alpha}}{n\left(\frac{\beta}{\alpha}-S\right)+G} \qquad (15)$$

and on a finite difference basis:

$$DDI = \frac{(1-n_1)\,\overset{i+1}{\Delta_1}\left(\frac{\beta}{\alpha}-S\right) - \beta_o\,\overset{i+1}{\Delta_1}\frac{1}{\alpha} - \overset{i+1}{\Delta_1}\left(\frac{V_g}{\alpha N}\right)}{\overset{i+1}{\Delta_1 n}\left[\left(\frac{\beta}{\alpha}-S\right)_{i+1} + R_{av}\right]}$$

$$SDI = \frac{-m\beta_o\,\overset{i+1}{\Delta_1}\frac{1}{\alpha} + \overset{i+1}{\Delta_1}\left(\frac{V_g}{\alpha N}\right)}{\overset{i+1}{\Delta_1 n}\left[\left(\frac{\beta}{\alpha}-S\right)_{i+1} + R_{av}\right]} \qquad (16)$$

The recovery equation of this process is:

$$r = \sum_{o}^{i+1}\left\{(DDI)\,r_d + (SDI)\,r_s\right\} \qquad (17)$$

where r_s is the recovery by segregation. r_s has a very high value approaching (1—irreducible oil saturation) in this

The drawing shown here was inadvertently transposed with drawing shown as Figure 10 on Page 209. See Page 209 for segregation drive with counterflow.

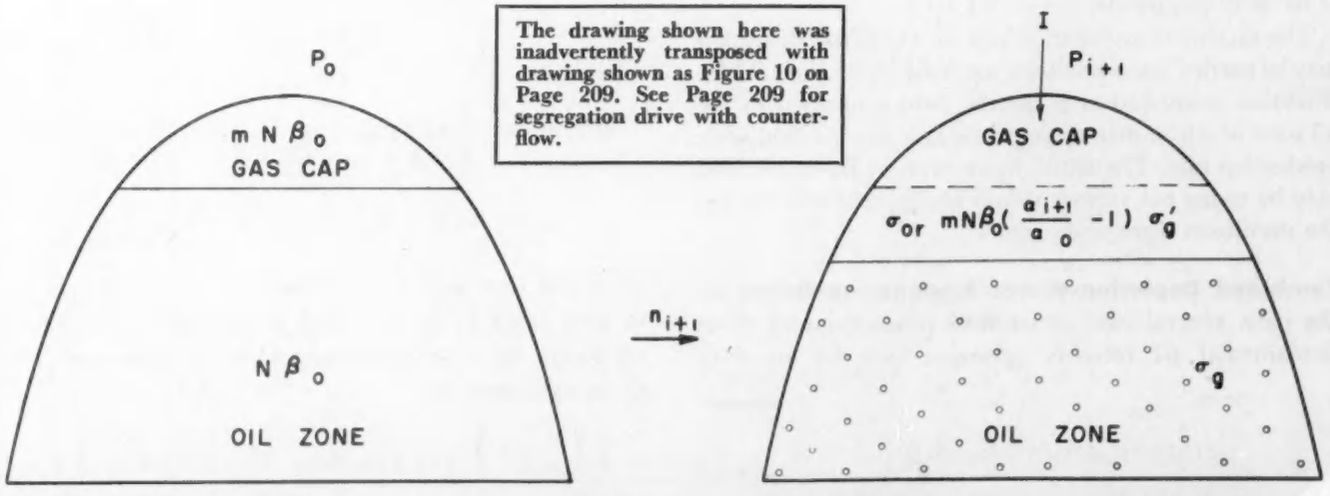

FIGURE 12—Segregation drive with counterflow: a process of oil recovery in which oil is displaced downstructure by a naturally expanding gas-cap as a result of oil and gas counterflow within the oil column.

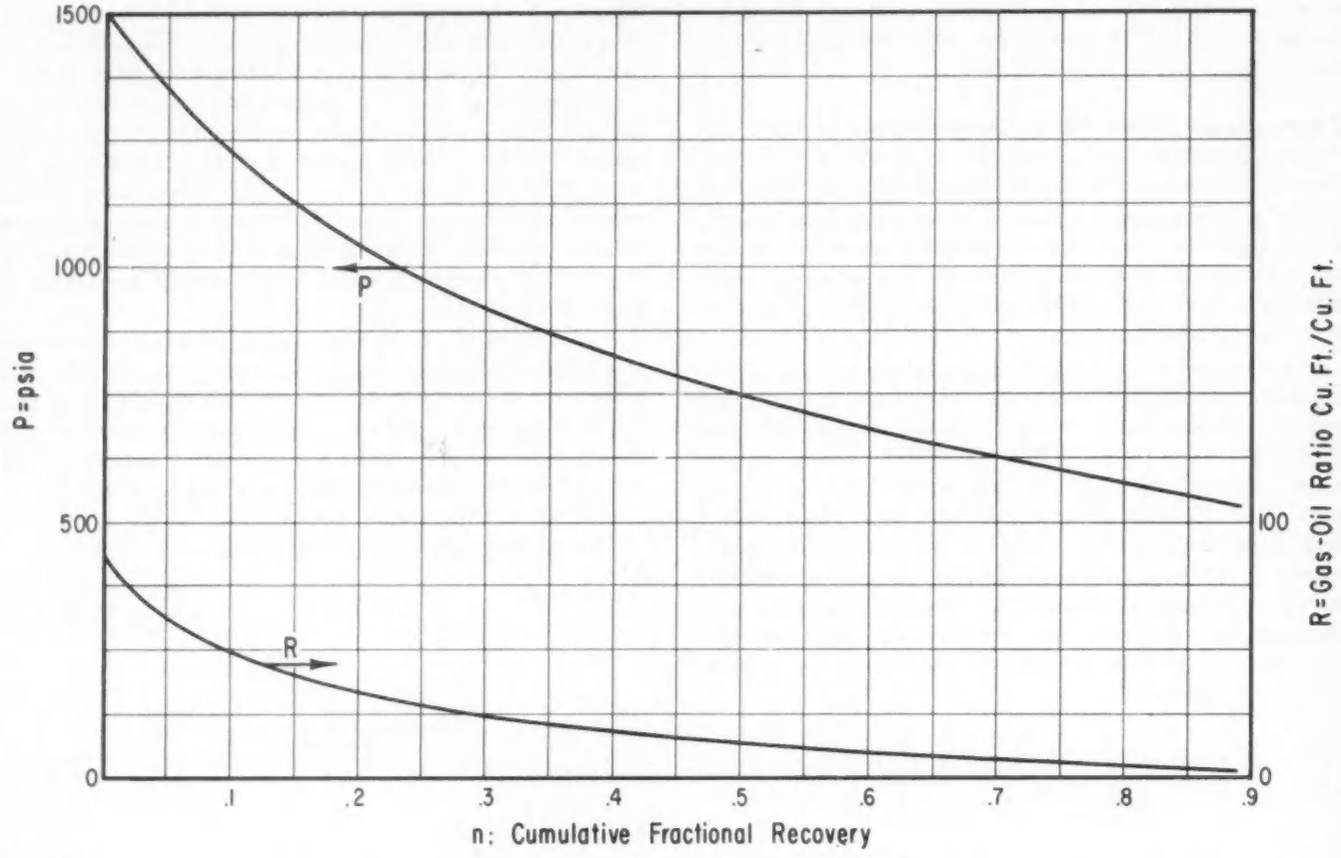

FIGURE 13—Segregation drive performance with counterflow, showing the characteristic monotonic decline in pressure and gas-oil ratio.

process since the value $q_t = q_o - q_g$ at the gas-oil interface is essentially nil. Segregation drive is therefore a process capable of yielding maximum oil recovery. This is obtained when DDI = 0 and when the proper balance is maintained between the rate of production Q_o and the rate at which gas segregates into the gas-cap. To a determined field pressure and production rate corresponds a definite gas saturation in the oil column. However, the free gas phase is not critical and has little effect on the displacement efficiency of the expanding gas-cap because of its small magnitude.

The maximum segregation rate at which this operation may be carried out is obtained when $K_g/\mu_g = K_o/\mu_o$. This condition is satisfied at a specific fluid saturation in the oil zone which in turn corresponds to a specific field wide production rate. The latter, however, may be determined only by trying out various values for Q_o that will bracket the maximum segregation rate.

Combined Depletion-Water-Segregation Drive. In the most general case of oil field production, all three fundamental oil recovery processes may be operative simultaneously. Two cases must be distinguished depending on whether or not gas is injected at the crest of the structure into the expanding gas-cap. An original gas-cap is not likely to be present owing to the water drive; for the sake of generality, however, one is postulated.

Combined Depletion-Water-Segregation Without Counterflow. (Figure 14) In this instance, gas injection into the gas-cap prevents active segregation of gas and oil in the oil column. The equations of the process may be written immediately on a finite difference basis. Pressure performance is first calculated on the basis of a simple depletion drive:

$$\Delta_i^{i+1} n = \frac{(1-n_i)\,\Delta_i^{i+1}\left(\frac{\beta}{\alpha}-S\right) - \beta_o\,\Delta_i^{i+1}\frac{1}{\alpha}}{\left(\frac{\beta}{\alpha}-S\right)_{i+1} + R_{sv}} \qquad (18a)$$

$$R = S + \frac{\beta}{\alpha}\cdot\frac{k_g}{k_o}\cdot\frac{\mu_o}{\mu_g}$$

$$\sigma_i = \sigma_w + (1-\sigma_w)\frac{(1-n)\,\beta}{\beta_o}$$

Then the time interval necessary for the field pressure to drop from P_i to P_{i+1} and to produce a fraction of oil based on a pre-assigned field-wide production rate Q_o is calculated by:

$$\Delta_i^{i+1}\theta = \frac{(1-n_i)\,\Delta_i^{i+1}\left(\frac{\beta}{\alpha}-S\right) - (1+m)\,\beta_o\,\Delta_i^{i+1}\frac{1}{\alpha} + \left(\frac{W_i - w_i}{N}\right)\Delta_i^{i+1}\frac{1}{\alpha}}{\frac{Q_o}{N}\left[\left(\frac{\beta}{\alpha}-S\right)_{i+1} + R_{sv}(1-I)\right] - \frac{c\,\Delta_i^{i+1}P - c_1}{N\alpha_{i+1}}}$$

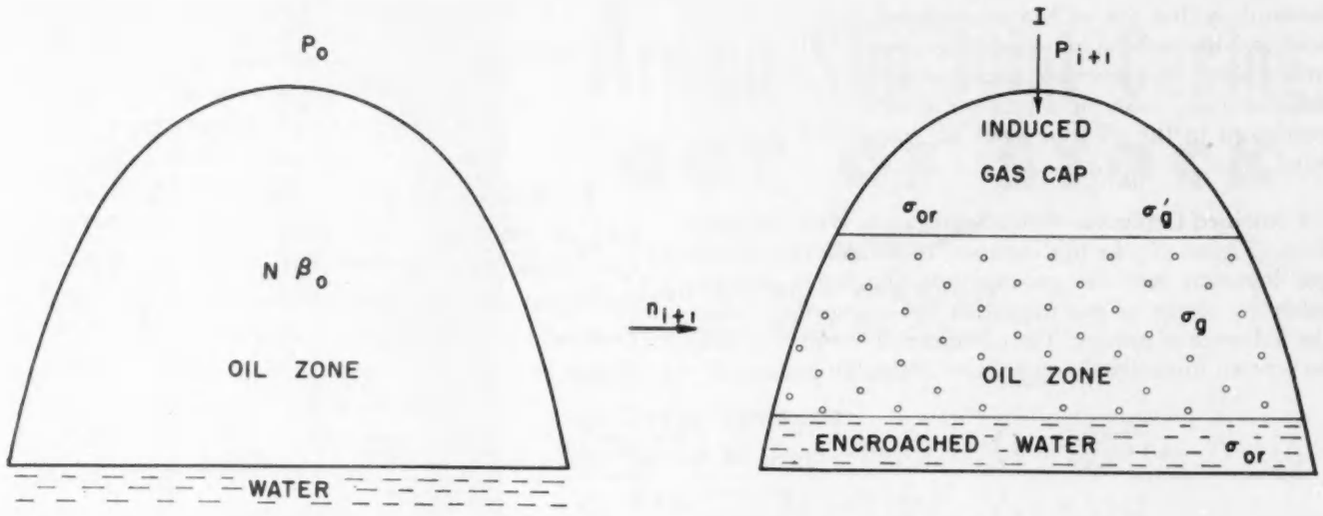

FIGURE 14—Combined Depletion-Water-Segregation Drive (without counterflow) is the process of oil recovery in which all three fundamental recovery mechanisms are simultaneously in operation.

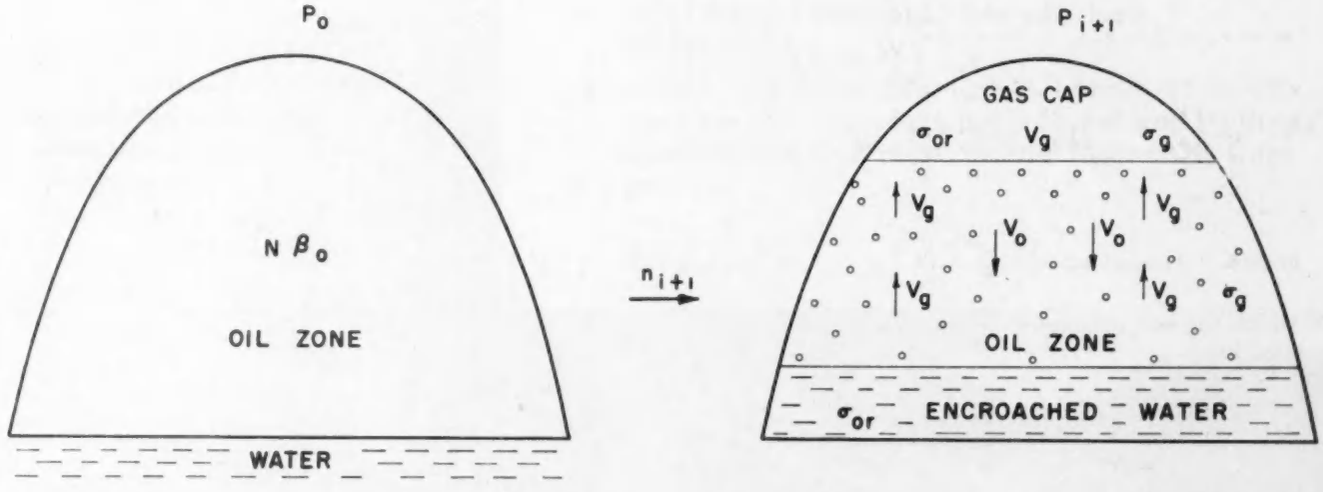

FIGURE 15—Combined Depletion-Water-Segregation Drive (with counterflow) is the process of oil recovery in which all three fundamental recovery mechanisms are simultaneously in operation.

in which the net volumetric water encroachment is evaluated from:

$$W_i - w_i = c\sum_{o}^{i} \Delta P \cdot \Delta\theta - c_i \sum_{o}^{i} \Delta\theta \qquad (18b)$$

The driving indices of the combined process on a finite basis are:

$$DDI = \frac{N\left[\left(\frac{\beta}{\alpha} - S\right) - \left(\frac{\beta_o}{\alpha} - S_o\right)\right] - GI}{n\left(\frac{\beta}{\alpha} - S\right) + G}$$

$$WDI = \frac{\frac{1}{\alpha}(W - w)}{n\left(\frac{\beta}{\alpha} - S\right) + G} \qquad (19)$$

$$SDI = \frac{m\beta_o N\left(\frac{1}{\alpha_o} - \frac{1}{\alpha}\right) + GI}{n\left(\frac{\beta}{\alpha} - S\right) + G}$$

On a finite difference basis the driving indices are written:

$$DDI = \frac{(1 - n_i)\,\Delta_i^{i+1}\left(\frac{\beta}{\alpha} - S\right) - \beta_o \Delta_i^{i+1}\frac{1}{\alpha}}{\Delta_i^{i+1} n\left[\left(\frac{\beta}{\alpha} - S\right) + R_{sv}\right]}$$

$$WDI = \frac{\Delta_i^{i+1}\left(\frac{W - w}{N\alpha}\right)}{\Delta_i^{i+1} n\left[\left(\frac{\beta}{\alpha} - S\right) + R_{sv}\right]} \qquad (20)$$

$$SDI = \frac{-m\beta_o \Delta_i^{i+1}\frac{1}{\alpha} + \Delta_i^{i+1} n \cdot R_{sv} \cdot I}{\Delta_i^{i+1} n\left[\left(\frac{\beta}{\alpha} - S\right) + R_{sv}\right]}$$

Over-all recovery:

$$r = \sum_{o}^{i+1}\left\{(DDI)r_d + (WDI)r_w + (SDI)r_g\right\} \qquad (21)$$

The above performance equations are written on the

assumption that the wells are completed solely in the oil zone and that producing conditions at the wells are controlled solely by saturation conditions in said oil zone. In this particular case, field pressure determines saturation conditions in the oil zone since no segregation is postulated.

Combined Depletion-Water-Segregation With Counterflow. (Figure 15) In this instance, there may not be any gas injection into the gas-cap, and the latter expands solely by virtue of gas migration by counterflow under the influence of gravity. The equations of the process may be written immediately on a finite difference basis:

$$\overset{i+1}{\Delta_i}\theta = \frac{(1-n_i)\,\overset{i+1}{\Delta_i}\left(\frac{\beta}{\alpha}-S\right) - (1+m)\,\beta_o\,\overset{i+1}{\Delta_i}\frac{1}{\alpha} + \left(\frac{W_i-w_i}{N}\right)\overset{i+1}{\Delta_i}\frac{1}{\alpha}}{\frac{Q_o}{N}\left[\left(\frac{\beta}{\alpha}-S\right)_{i+1}+R_{av}\right]-\frac{c\,\overset{i+1}{\Delta_i}P-c_i}{N\alpha_{i+1}}}$$

$$R = S+\frac{\beta}{\alpha}\cdot\frac{k_g}{k_o}\cdot\frac{\mu_o}{\mu_g} \qquad (22a)$$

$$\sigma_i = \sigma_w + (1-\sigma_w)\,\frac{(1-n)\,\beta-\left[\frac{V_g}{N}+m\beta_o\left(\frac{\alpha}{\alpha_o}-1\right)\right]\frac{\sigma_{or}}{\sigma_g'}}{\beta_o-\left[\frac{V_g}{N}+m\beta_o\left(\frac{\alpha}{\alpha_o}-1\right)\right]\frac{1}{\sigma_g'}}$$

$$\overset{i+1}{\Delta_i}V_g = A\left(\frac{K_g}{\mu_g}\text{ or }\frac{K_o}{\mu_o}\right)\frac{\Delta\vartheta}{1033}\sin\alpha\cdot\overset{i+1}{\Delta_i}\theta$$

$$nr_n = S_o+(1-n)\,S-\frac{1}{\alpha}\left[\frac{V_g}{N}+\frac{\sigma_g}{\sigma_g'}\left\{\beta_o\sigma_g'-\left[\frac{V_g}{N}+m\beta_o\left(\frac{\alpha}{\alpha_o}-1\right)\right]\right\}\right]$$

in which the net volumetric water encroachment is calculated by:

$$W_i-w_i = c\sum_{o}^{i}\Delta P\cdot\Delta\theta - c_i\sum_{o}^{i}\Delta\theta \qquad (22b)$$

The driving indices of the combined process on a finite basis are:

$$DDI = \frac{N\left[\left(\frac{\beta}{\alpha}-S\right)-\left(\frac{\beta_o}{\alpha}-S_o\right)\right]-\frac{V_g}{\alpha}}{n\left(\frac{\beta}{\alpha}-S\right)+G}$$

$$WDI = \frac{\frac{1}{\alpha}\left(W-w\right)}{n\left(\frac{\beta}{\alpha}-S\right)+G} \qquad (23)$$

$$SDI = \frac{mN\beta_o\left(\frac{1}{\alpha_o}-\frac{1}{\alpha}\right)+\frac{V_g}{\alpha}}{n\left(\frac{\beta}{\alpha}-S\right)+G}$$

On a finite difference basis, the driving indices are written:

$$DDI = \frac{(1-n_i)\,\overset{i+1}{\Delta_i}\left(\frac{\beta}{\alpha}-S\right)-\beta_o\,\overset{i+1}{\Delta_i}\frac{1}{\alpha}}{\overset{i+1}{\Delta_i}n\left[\left(\frac{\beta}{\alpha}-S\right)_{i+1}+R_{av}\right]}$$

$$WDI = \frac{\overset{i+1}{\Delta_i}\left(\frac{W-w}{N\alpha}\right)}{\overset{i+1}{\Delta_i}n\left[\left(\frac{\beta}{\alpha}-S\right)_{i+1}+R_{av}\right]} \qquad (24)$$

$$SDI = \frac{-m\beta_o\,\overset{i+1}{\Delta_i}\frac{1}{\alpha}+\overset{i+1}{\Delta_i}\left(\frac{V_g}{\alpha N}\right)}{\overset{i+1}{\Delta_i}n\left[\left(\frac{\beta}{\alpha}-S\right)_{i+1}+R_{av}\right]}$$

The above equations are written on the assumption that the wells are completed solely in the oil zone and that producing conditions at the wells are controlled by saturation conditions in said oil zone. In this particular case, field pressure no longer determines saturation conditions in the oil zone since oil replenishment takes place in it as a result of oil and gas counterflow in the oil column.

Overall recovery:

$$r = \sum_{o}^{i+1}\left[(DDI)r_d+(WDI)r_w+(SDI)r_s\right] \qquad (25)$$

The set of equations developed above constitute the Universal Theory of Oil Reservoir Engineering; the last set of equations may, in fact, be considered as fully general if it were not for the fact that gas injection is absent from it. It is believed that the two sets of equations (18) and (22) are more appropriate for they are incompatible; i.e., when gas-cap gas injection is resorted to, gravity segregation of oil and gas is almost impossible. However, segregation is still possible under conditions of dispersed gas injection, a case which has not been specifically considered in combination with water and segregation drives.

From the generalized set of equations, one may revert to simpler combinations of drive by merely dropping the terms not applicable to the conditions at hand.

To Be Continued

Part 3

In November

The third and final installment of this series by Dr. Pirson will appear in your November issue of WORLD OIL. It will take up Combination Drive Fields: Unitization, proration, and conservation. Part 1 appeared in the September issue (Pages 119-124).

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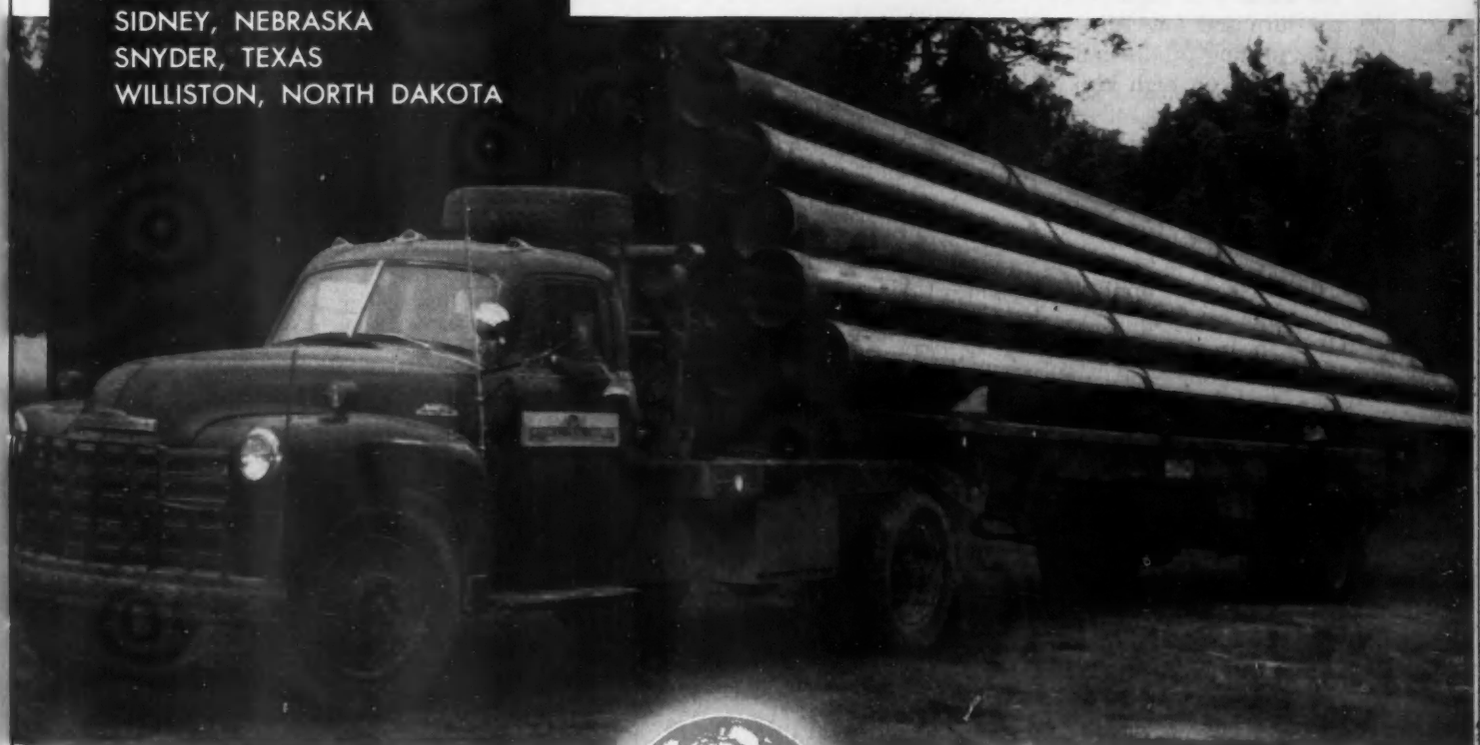

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For Your Production File (Part 3)

'Graph System' Gives Gas Lift A Lift

Application of the subsurface plunger with "stop-cock" and intermitting gas-lift installations can be used advantageously.

By E. D. McMURRY
McMurry Oil Tool Specialties, Inc.
Houston

IN GAS LIFT installations, the subsurface plunger finds its best use in wells that produce less than 100 barrels of liquid daily. Six basic applications of the subsurface plunger are:

1. "Stop-cock" removal of liquids from wet gas wells.
2. "Stop-cock" production of high ratio flowing oil wells.
3. "Stop-cock" production of gas lift wells with high bottom hole pressure and low PI's.
4. Intermitting production with gas lift valves on high bhp and low PI wells.
5. Intermitting production with gas lift valves in wells with low bhp and with high or low PI's.
6. Removing paraffin from any of the above types of wells.

On the first three applications, the tubing is shut in to allow the plunger to fall to the tubing stop on bottom. Under these conditions, usually no bypass valve is required through the subsurface plunger and a spring bumper normally is attached to the bottom of the plunger.

The lubricator design for the first three applications will in some cases require an automatic shutoff control so that the motor valve on flow line will close on arrival of the plunger.

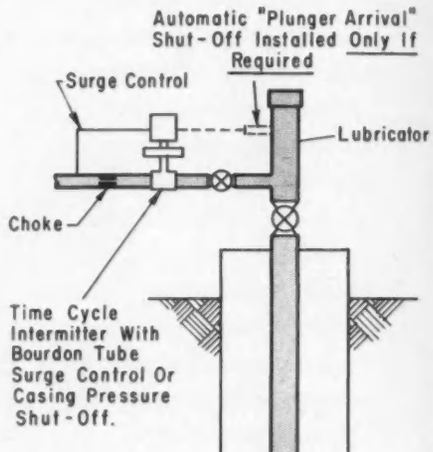
When the subsurface plunger is used in conjunction with standard intermitting gas lift valves (applications 4 and 5) the tubing is left open at all times. This requires a bypass valve that opens when the plunger strikes the surface and closes when the plunger strikes the tubing stop on bottom. In wells of this type, the rate of fall for the plunger is relatively slow, allowing fluid to build up over the tubing stop; therefore a bumper spring on top of the stop often is not required.

Common Misconceptions. Many operators have been led to believe that it is necessary to obtain a tight fit between tubing and plunger for good results on a plunger installation. Under the vast majority of conditions this is *not true* because of the plunger speed. At speeds in excess of 300 feet per minute, a turbulence seal is acquired which is quite effective and eliminates the need for tight fits. In actual practice, very few plungers run at speeds less than 300 feet per minute. In attempting to obtain too tight a seal between the plunger and tubing, mechanical difficulties can be multiplied to the extent that the installation would be prohibitive. Very successful plunger operations may be expected if the tubing I.D. will gage as follows for:

2⅜" O.D.: 1⅞" I.D. gage
2⅞" O.D.: 2⅝" I.D. gage
Gage length: 2 feet

Oversize plunger fits can be furnished for those rare cases wherein speeds of less than 300 feet per minute are necessary. A considerable number of plungers have been installed in wells having high bhp and very low PI's with the hope of obtaining additional oil recovery. Usually the disappointing results are not the fault of the subsurface plunger. If a well is already being produced with a drawdown on bottom that exceeds 50 percent of the static reservoir pressure (refer to Graph G in Part 2) the addition of a plunger will not increase oil recovery because the well is producing at a maximum before the plunger installation. The only apparent benefits realized would be keeping the tubing clean of paraffin and reducing input gas/fluid ratios.

Many plungers have been installed in high ratio wells in an attempt to reduce the ratio. This is quite possible where the high ratio is being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Retrievable Standing Valve
Retrievable Tubing Stop

FIGURE 8—A typical "stop-cock" installation of the subsurface plunger designed for a high ratio flowing oil well or wet gas well. The installation can be made without pulling tubing and is very beneficial toward prolonging the flowing life of both type wells.

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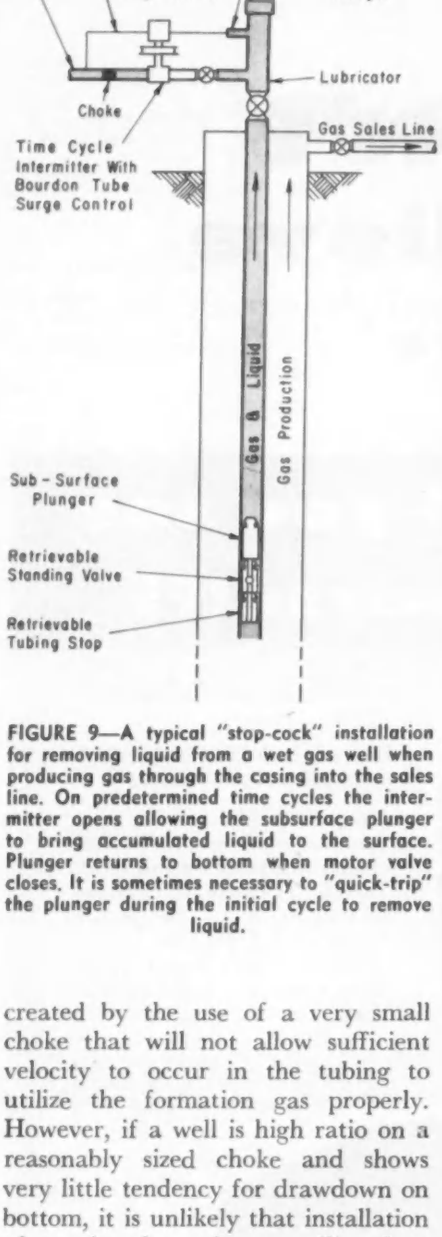

FIGURE 9—A typical "stop-cock" installation for removing liquid from a wet gas well when producing gas through the casing into the sales line. On predetermined time cycles the intermitter opens allowing the subsurface plunger to bring accumulated liquid to the surface. Plunger returns to bottom when motor valve closes. It is sometimes necessary to "quick-trip" the plunger during the initial cycle to remove liquid.

created by the use of a very small choke that will not allow sufficient velocity to occur in the tubing to utilize the formation gas properly. However, if a well is high ratio on a reasonably sized choke and shows very little tendency for drawdown on bottom, it is unlikely that installation of a subsurface plunger will reduce the ratio.

Plunger Application In Wet Gas Wells. The subsurface plunger primarily was designed for artificially lifting oil wells with the energy supplied by formation gas, compressed gas or from a high-pressure gas well. In the past three years, use of the plunger has been best applicable in the removal of liquids from wet gas wells.

A recommended procedure to keep liquid removed from a wet gas well is as follows: A retrievable tubing stop (preferably with standing valve) is placed on bottom of the tubing string and a time-cycle intermitter is placed on the flow line. Once or twice a day (or often as desired) the time-cycle intermitter is allowed to close which will cause the plunger to fall (500 to 1000 feet per minute in gas wells) to the bottom of well. When the intermitter re-opens, the plunger rises to surface lifting the accumulated liquid. This cycle is repeated as necessary to keep the well flowing into the sales line. As the well degrades during the cycle it may become necessary to vent the gas to a low pressure separator or to the atmosphere. There are several ways to accomplish this; the simplest installations are shown in Figures 8 and 9. The standing valve shown on bottom is preferred so that liquid is not forced back into the formation during the shut-in period also tending to reduce the number of daily cycles. The lubricator may be equipped with a unit that will shut off the intermitter automatically the moment the plunger arrives at the surface. This unit is not required unless the well is being vented. When used it assures the well does not remain open any longer than is necessary to get the plunger to surface.

The application of a plunger in wet gas wells (Figures 8 and 9) will extend the flowing life indefinitely. Installation can be made at a very reasonable cost without pulling tubing and ordinarily the equipment pays itself out rapidly.

Plunger Operation In High Ratio Wells. The same installation is run in flowing high ratio oil wells as that in a wet gas well. Operation of equipment also is identical to that of a wet gas well where the automatic shutoff is usually installed. To obtain proper results the ratio should be at least 300 cubic feet per barrel per each 1000 feet of depth. In a solution drive reservoir that will always be semi to high ratio, this is an excellent low cost method of recovering liquids. As long as the ratio equals or exceeds this figure, the well will produce by itself with no outside gas whatsoever and in many cases produce in this manner until depletion.

If a well is dead when equipment is installed, a swab is necessary to start the installation. Although it is apparent that ratios will be too low for this type installation in later life of the reservoir, it is often used as a temporary measure to produce the well. Cost of an installation of this type is low compared to expensive down-hole pumping equipment. If outside gas

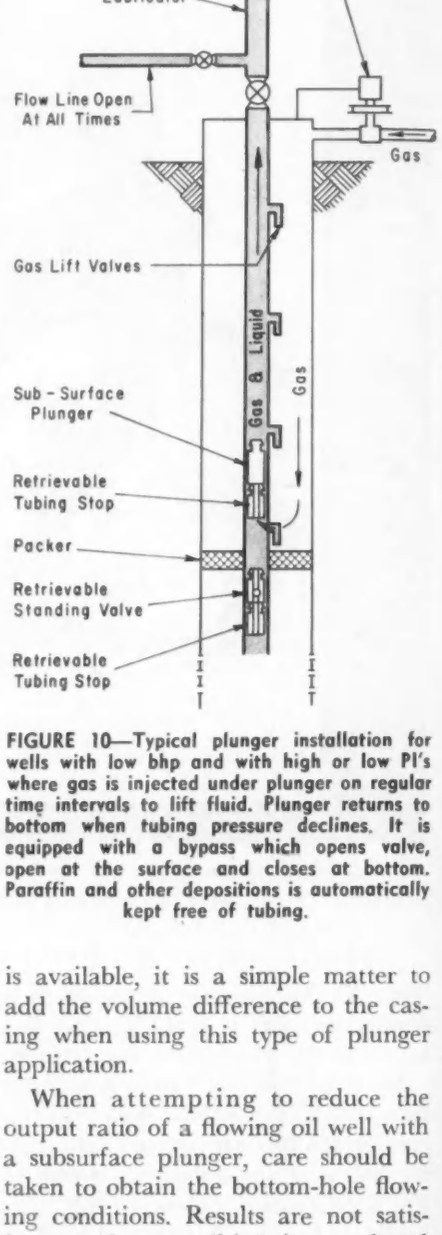

FIGURE 10—Typical plunger installation for wells with low bhp and with high or low PI's where gas is injected under plunger on regular time intervals to lift fluid. Plunger returns to bottom when tubing pressure declines. It is equipped with a bypass which opens valve, open at the surface and closes at bottom. Paraffin and other depositions is automatically kept free of tubing.

is available, it is a simple matter to add the volume difference to the casing when using this type of plunger application.

When attempting to reduce the output ratio of a flowing oil well with a subsurface plunger, care should be taken to obtain the bottom-hole flowing conditions. Results are not satisfactory when a well is being produced at a rate sufficient to maintain a good velocity in the tubing and there is little drawdown on bottom. When abnormal drawdown conditions are creating high ratios, the plunger may be put to work in such manner as to control the bottom-hole flowing pressure and utilize reservoir energy to work more efficiently, thereby reducing the output ratios.

As previously mentioned, a retrievable standing valve should be used in this installation to retain fluid accumulated in tubing during the shut-in period. This eliminates fluid from being forced back into the formation.

This installation finds wide application in wells of all depths, 1000 feet to 12,000 feet.

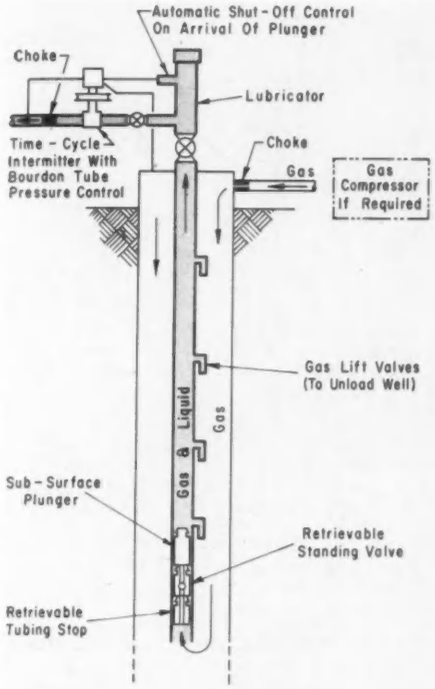

FIGURE 11—This type of installation, using the "stop-cock" method of gas lift, has found wide use in wells of high bhp low PI category (100 barrels daily or less). The plunger makes a trip to the surface each time the motor valve opens and automatically closes motor valve when arriving. If the formation gives up as much as 300 cubic feet per barrel of liquid per 1000 feet of depth, no outside gas is necessary to run plunger.

Casing Flow Operation of Plunger In Wet Gas Wells. Figure 9 shows a very simple but effective way to prolong the flowing life of a weak wet gas well. The subsurface plunger is run up the tubing at regular intervals to keep liquids out while the well flows continually through casing into the sales line. The tubing is vented to a low pressure system or to the atmosphere. If desirable, all liquids can be recovered by routing the vent line through a separator.

Because of the size ratio of casing to tubing, it is sometimes necessary to "quick trip" the plunger to remove liquid entering the tubing from casing during the initial cycle by running the plunger two or three times in rapid succession. Because of low friction loss or flowing gradient in the casing, this method of producing a wet gas well allows the highest possible surface flowing pressures to overcome the sales line pressure.

Plunger Operation With Standard Intermitting Gas Lift (Figure 10). The installation of a plunger with intermitting gas lift valves can give beneficial results as follows:

- Input gas/fluid ratios lowered;
- Paraffin deposits eliminated;
- An increase in liquid may be expected on wells having low bhp and good to high PI's. (A liquid increase of major consequence should not be expected if the well is of low PI category and is already being produced with a drawdown of over 2 percent. (See Graph G in Part 2.)

A retrievable standing valve should be set below the producing gas lift valve and a retrievable tubing stop immediately above. The subsurface plunger installed above the stop, is equipped with a by-pass valve that opens when it strikes the surface and closes when it strikes the tubing stop on bottom. During the time that gas *is not* injected into tubing string, plunger falls to the stop and closes the by-pass valve. Gas injected into the tubing immediately below the plunger, drives the plunger to surface lifting all accumulated fluid. The by-pass valve opens when the plunger strikes the surface and when pressure from the tail gas dissipates to separator pressure, the plunger returns to tubing stop on bottom. The cycle is repeated as often as necessary to produce liquid given up by the formation.

Flowing bottom-hole pressures as low as 10 (psi) per 1000 feet of depth at rates of flow of 50 barrels daily have been recorded with installations of this type, giving excellent drawdown results.

Plunger Operation in High BHP, Low PI Wells. Figure 11 illustrates an ideal gas lift installation for a well that has a high bhp, very low PI, and semi-high to high ratio but, unable to flow continually of its own accord. An outside source of gas is required at least temporarily to get the installation started. After the initial kickoff, if the formation ratio per barrel is 300 cubic feet for each 1000 feet in depth, the well will continue to produce with its own energy.

Gas lift valves are used to kick the well down to where input gas can be blown around bottom. This type installation is one of the simplest and most economical for artificial lift of the deep, low PI category type well. Total costs including a compressor are far below that of deep well, long-stroke subsurface pumping equipment and the results are equal to and in many cases superior. Single well installations with a compressor may be designed for rotative systems in conjunction with this equipment where gas is returned to the well.

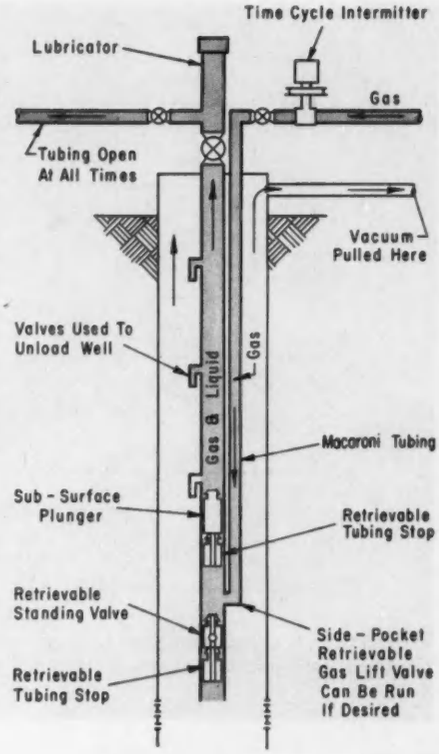

FIGURE 12—Gas can be injected at the bottom of the hole without the use of packers with this installation, recommended for open hole completions. This installation is typical where it is desirable to pull a vacuum on the formation, or where the well has a very low bhp and very high PI. Under either condition, well is allowed to fill in against atmospheric pressure or less.

Two-String Plunger Operation. On rare occasions the operator will want to pull a vacuum on the casing of low bhp wells and produce a well against the atmosphere if completion is in open hole, or long section of the formation have been perforated. Figure 12 illustrates a very simple installation of this type. A major operator in California has used this type installation successfully on numerous wells, producing from deep, low bhp sands having good PI's. Production was 30 percent greater with the subsurface plunger on tests of the same well and under identical conditions over tests without a plunger. Cost of operation was less, while recovery was equal and sometimes greater than that of downhole pumps. Vacuum was pulled on the casing of these wells at all times. Shallow stripper wells may also be equipped in this manner at very low cost with operating pressures as low as 100 (psi). —**The End**

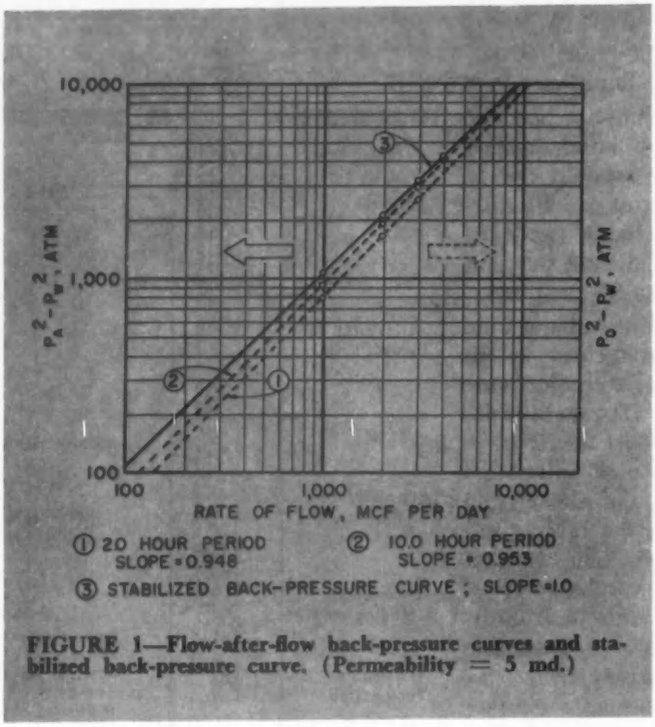

FIGURE 1—Flow-after-flow back-pressure curves and stabilized back-pressure curve. (Permeability = 5 md.)

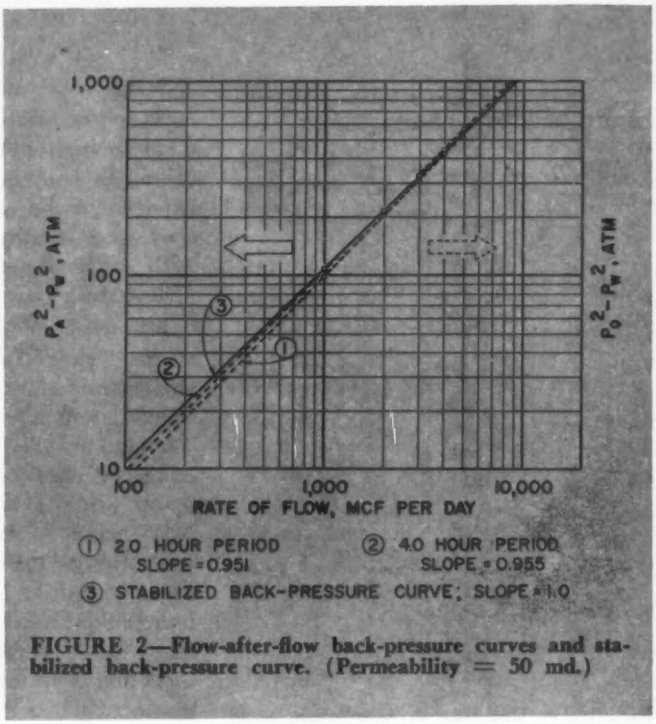

FIGURE 2—Flow-after-flow back-pressure curves and stabilized back-pressure curve. (Permeability = 50 md.)

Further Studies Are Needed

How Does Theoretical Gas Well

By John S. Miller
U. S. Bureau of Mines, Bartlesville

MODERN THEORETICAL treatments of unsteady state-gas flow based on Darcy's law do not fully explain gas-well performance. However, these theories do offer explanations of the changes of well performance with time. Further theoretical studies of gas flow are needed; careful consideration should be given to nonviscous flow which may be an important factor in the performance of gas wells.

Several papers on the theory of gas flow through porous media have been published recently.[1, 2, 4, 5, 7, 8, 10, 11, 12, 14] Equations developed by Aronofsky et al[1, 2, 12] permit the calculation of the performance of a hypothetical gas well under transient and stabilized conditions. This article compares the results of calculations based on existing theories with the results of actual tests on gas wells.

One of two procedures usually is followed in the field testing of gas wells. The early method of Rawlins and Schellhardt[15] may be termed the "flow-after-flow" back-pressure test. The more recently developed procedure is the "isochronal" performance method of Cullender.[9] Deliverability tests required by State regulatory bodies may be considered special types of either test.

Results from calculations of the performance of a hypothetical gas well by the methods of Aronofsky and Jenkins do not show all of the usual characteristics of an actual test of a well. The actual and theoretical results differ in what is usually termed the slope of the back-pressure or isochronal curves. (The term "slope" commonly used in back-pressure tests actually is the reciprocal of the mathematical slope.) This difference is attributed to deviations from Darcy's law during actual gas flow.

Aronofsky et al[1, 2] and Bruce et al[4] have solved the partial differential gas flow equation by numerical means. The work of Aronofsky and Jenkins[2] shows that these numerical results may be represented by the following equations:

$$P_T\overline{Q} - 4\,\overline{Q}\,\theta = 2\left[\,(1-\overline{Q}\,\theta)^2 - \left(\frac{P_w}{P_o}\right)^2\,\right] \qquad (1)$$

for transient conditions and

$$P_a^2 - P_w^2 = P_o^2\left[\frac{\overline{Q}}{2}\ln\left(0.472\frac{r_r}{r_w}\right)\right] \qquad (2)$$

for stabilized conditions, where

$$\overline{Q} = \frac{2QP_a\mu}{\pi P_o^2 Kh}\,;\ \tau = \frac{KP_o t}{\varphi\mu\, r_w^2}\,;$$

$$\text{and } \theta = \tfrac{1}{2}\,\tau\left(\frac{r_w}{r_r}\right)^2.$$

The function P_T was developed by van Everdingen and Hurst,[17] for transient flow of slightly compressible liquids in porous media, who tab-

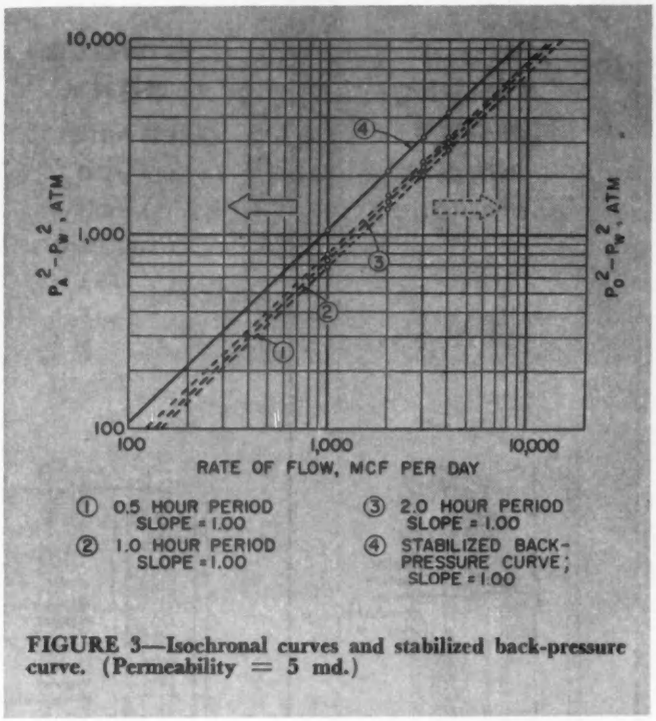

FIGURE 3—Isochronal curves and stabilized back-pressure curve. (Permeability = 5 md.)

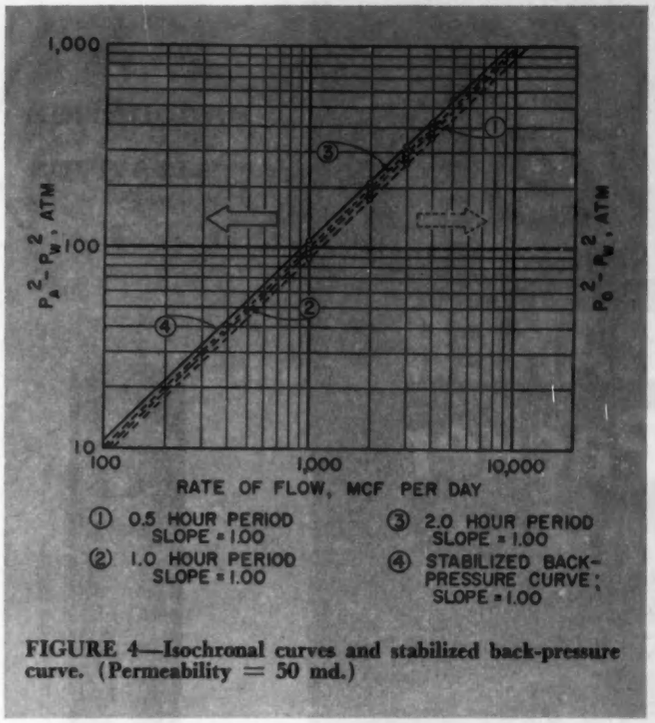

FIGURE 4—Isochronal curves and stabilized back-pressure curve. (Permeability = 50 md.)

Performance Compare With Field Data?

ulated values of P_τ for values of τ less than 1000 and showed that, for values of τ greater than 1000, P_τ may be represented by the equation

$$P_\tau = \tfrac{1}{2} (\ln_\tau + 0.809). \qquad (3)$$

Back-pressure curves for the flow-after-flow method may be calculated by equation (1) and application of the principle of superposition.[11,17]

A homogeneous reservoir, impervious at the boundaries and having a well along the axis, was assumed for the calculations. Specific properties of the reservoir were: Radius, 660 feet; wellbore radius, 0.5 foot, thickness, 50 feet; effective porosity, 18 percent; permeability, 5 and 50 millidarcys; gas viscosity, 0.012 centipoise; and initial uniform pressure, 100 atmospheres.

Flow-after-flow Method. A reservoir permeability of five millidarcys and successive flow rates of 1, 2, and 3 mmcf per day for two-hour periods were assumed. The wellbore pressures calculated at the end of each two-hour period were used to derive the back-pressure curve for this test. These calculations were repeated for the same flow rates, each of 10-hour duration. The calculated back-pressure curves are shown in Figure 1. Next, it was assumed that the permeability of the reservoir was 50 millidarcys. Successive flow rates of 1, 2, 3 and 4 mmcf per day were assumed for two- and four-hour intervals. The above theoretical tests correspond to the flow-after-flow back-pressure technique. The results of these calculations are illustrated as backpressure curves in Figure 2. The slopes of the transient back-pressure curves under the several conditions of testing are summarized in Table 1.

TABLE 1
Comparison of Slopes of the Flow-After-Flow and Isochronal Back-Pressure Curves

FLOW-AFTER-FLOW				ISOCHRONAL			
Transient	Stabilized	Time, Hours	Permeability, md.	Preliminary	Stabilized	Time, Hours	Permeability, md.
0.948	1.00	2	5	1.00	1.00	0.5	5
.953	1.00	10	..	1.00	1.00	1.0	..
....	....	..	..	1.00	1.00	1.5	..
....	....	..	..	1.00	1.00	2.0	..
.951	1.00	2	50	1.00	1.00	.5	50
.955	1.00	4	..	1.00	1.00	1.0	..
....	....	..	..	1.00	1.00	1.5	..
....	....	..	..	1.00	1.00	2.0	..

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PRODUCTION APPLICATIONS

SINGLE ZONE Normal Completion

SINGLE ZONE Permanent Type Well Completions

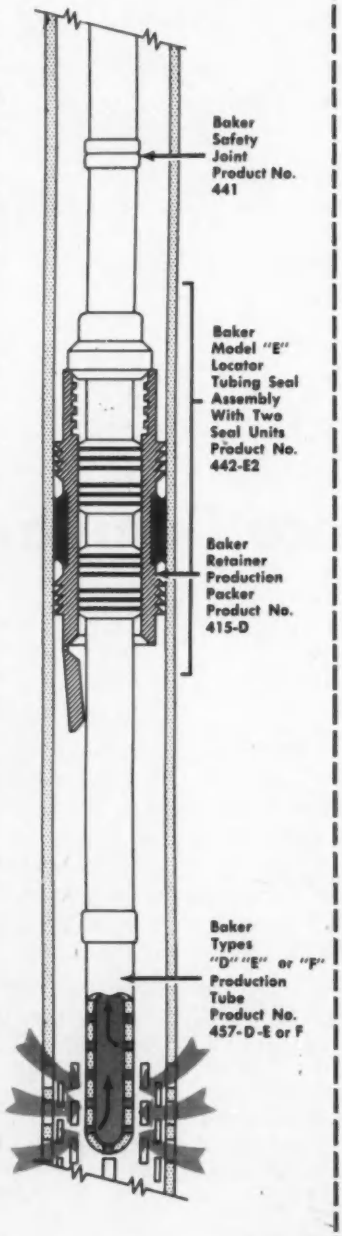
Baker Retainer
Production Packer
Product No. 415-D

FEATURES

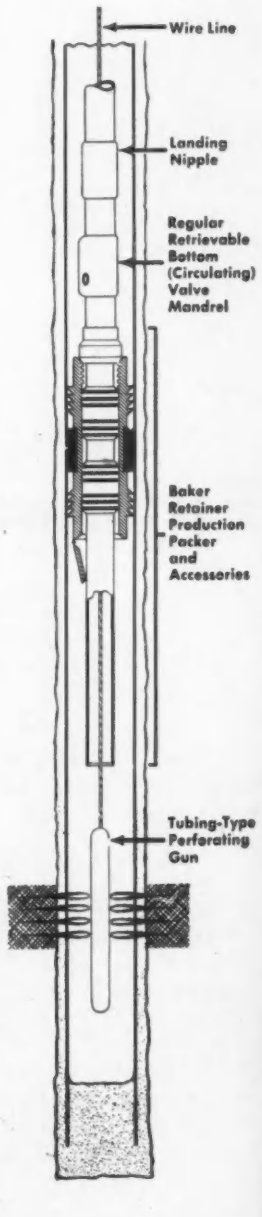
Holds any pressure from either above or below that is safe for the casing, even under temperatures in excess of 300°F.

Pack-off is independent of set-down weight or tension. Tubing string is free; just pick up (or unlatch and pick up) to remove it.

Use it as a squeeze and testing tool or as a temporary or permanent bridge plug in conjunction with any production application.

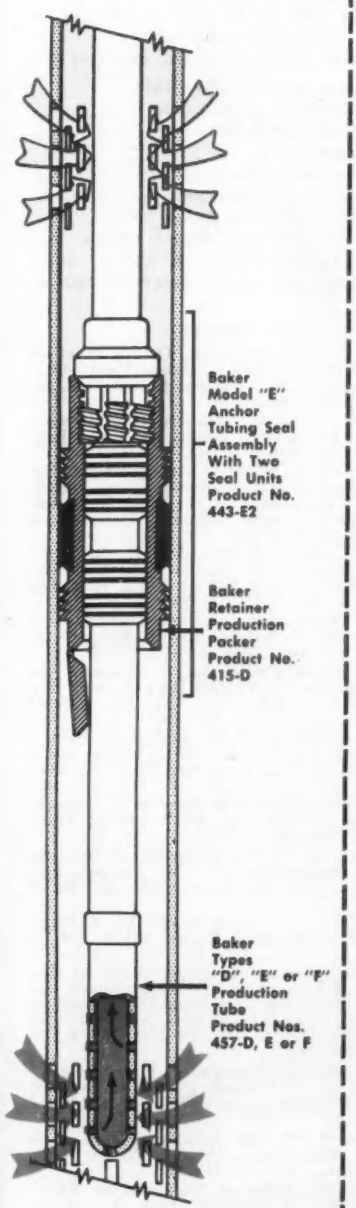

Baker Safety Joint Product No. 441
Baker Model "E" Locator Tubing Seal Assembly With Two Seal Units Product No. 442-E2
Baker Retainer Production Packer Product No. 415-D
Baker Types "D" "E" or "F" Production Tube Product No. 457-D-E or F

Illustrates Packer set in casing with Locator Tubing Seal Assembly and Production Tube installed for single-zone production.



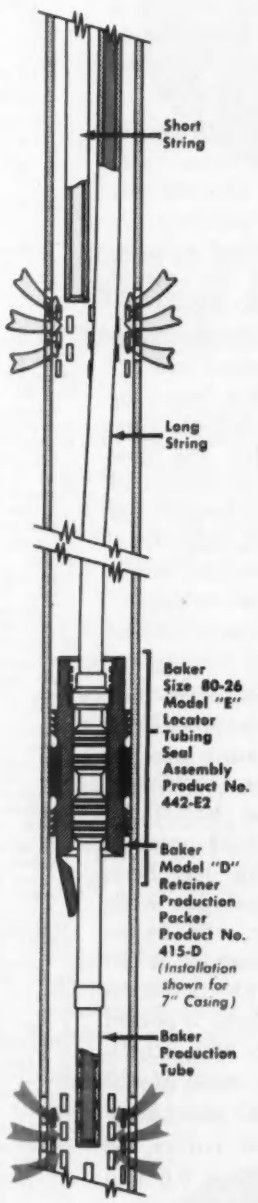
Illustrates typical Permanent-Type Well Completion Hook-Up showing perforating operation through and below the Packer.

DUAL ZONE
Normal Completion


Baker Model "E" Anchor Tubing Seal Assembly With Two Seal Units Product No. 443-E2
Baker Retainer Production Packer Product No. 415-D
Baker Types "D", "E" or "F" Production Tube Product Nos. 457-D, E or F

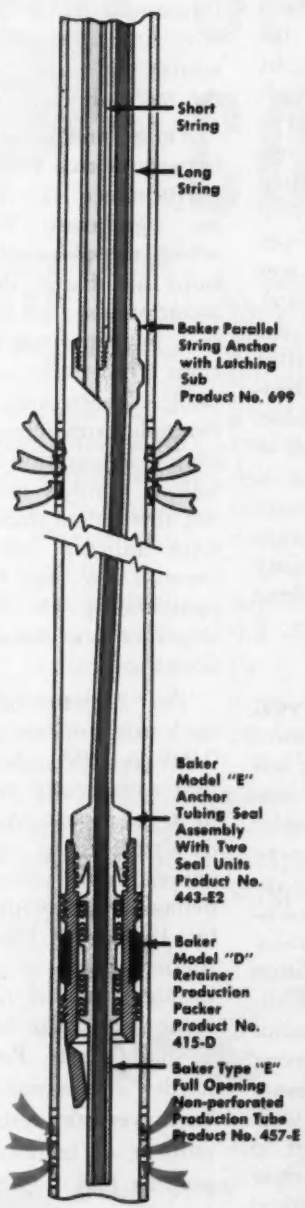
Illustrates Packer set in casing, with anchored production string for dual-zone production. Tubing can be released from Packer by rotating to right.

DUAL ZONE
Parallel String Short String Hanging Free


Short String
Long String
Baker Size 80-26 Model "E" Locator Tubing Seal Assembly Product No. 442-E2
Baker Model "D" Retainer Production Packer Product No. 415-D (Installation shown for 7" Casing)
Baker Production Tube

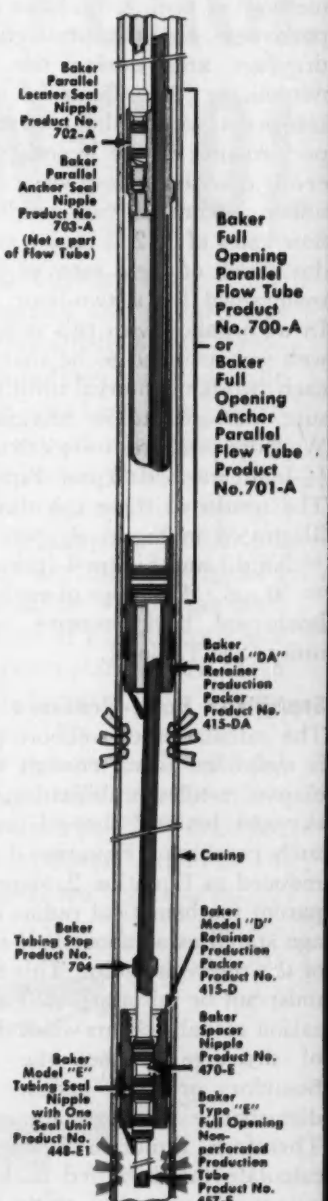
Permits removal of either string independently of the other regardless of sequence. Full-Opening (Tubing I.D.) Long String to lower zone.

DUAL ZONE
Parallel String Short String Anchored


Short String
Long String
Baker Parallel String Anchor with Latching Sub Product No. 699
Baker Model "E" Anchor Tubing Seal Assembly With Two Seal Units Product No. 443-E2
Baker Model "D" Retainer Production Packer Product No. 415-D
Baker Type "E" Full Opening Non-perforated Production Tube Product No. 457-E

Permits removal of either string independently of the other, however long string must be run first. Short string pulled first. Full-Opening (Tubing I.D.) Long String.

DUAL ZONE
Parallel String Two-Packer Hook-up


Baker Parallel Locator Seal Nipple Product No. 702-A or Baker Parallel Anchor Seal Nipple Product No. 703-A (Not a part of Flow Tube)
Baker Full Opening Parallel Flow Tube Product No. 700-A or Baker Full Opening Anchor Parallel Flow Tube Product No. 701-A
Baker Model "DA" Retainer Production Packer Product No. 415-DA
Casing
Baker Tubing Stop Product No. 704
Baker Model "D" Retainer Production Packer Product No. 415-D
Baker Spacer Nipple Product No. 470-E
Baker Model "E" Tubing Seal Nipple with One Seal Unit Product No. 448-E1
Baker Type "E" Full Opening Non-perforated Production Tube Product No. 457-E

Illustrates Two-Packer parallel string installation with each zone confined to its individual tubing string with full-opening to lower zone for use of all permanent-type completion tools.

The productivities for the two permeability values can be compared by referring to the stabilized back-pressure curves (Curve 3) in Figures 1 and 2. In Figure 1, where $P_a^2 - P_w^2$ equals 100, a productivity of 93 mcf per day is obtained for an assumed permeability of five millidarcys while in Figure 2, where $P_a^2 - P_w^2$ equals 100, a productivity of 940 mcf is obtained for an assumed permeability of 50 millidarcys. This illustrates the effect of permeability on productivity.

Isochronal Method. The isochronal method[9] of testing results in a simple pressure gradient throughout the drainage area during the test by minimizing the effects of multiple transients within the reservoir. The performance of the hypothetical reservoir described above was calculated under isochronal test conditions at flow rates of 1, 2, 3 and 4 mmcf per day. Each of these rates of flow was maintained for a two-hour interval. In accordance with this method, the well was assumed to be shut in after each two-hour interval until the pressure increased to its original value. Wellbore pressures were calculated at ½-hour intervals from Equation 1. The results of these calculations are illustrated in Figure 3 (permeability = 5 md.) and Figure 4 (permeability = 50 md.) The slope of each of these isochronal back-pressure curves is unity (See Table 1).

Stabilized Back-Pressure Curves. The calculation of wellbore pressures is simplified when enough time has elapsed to allow stabilization. Aronofsky and Jenkins[2] showed that under such conditions Equation 1 may be reduced to Equation 2, since the apparent mathematical radius of drainage stabilizes at about half the value of the reservoir radius. This condition must not be misinterpreted as stabilization actually occurs when the radius of drainage reaches the reservoir boundary or meets another pressure disturbance from an adjacent well. Therefore, Equation 2 was used to calculate the stabilized back-pressure curves corresponding to the transient curves and to the isochronal curves in Figures 1-4. The slope of each of these stabilized back-pressure curves was unity (Table 1) although the slopes of the transient flow-after-flow curves deviated from unity slightly, depending on the assumed test conditions.

Significantly, each of the isochronal curves for the hypothetical reservoir has a slope of 1.00. However, Cullender[9] reports data for actual wells having slopes ranging from 0.835 to 0.948. More recent field tests by this laboratory on several wells in six reservoirs have resulted in isochronal curves with slopes ranging from 0.57 to 0.83. Cullender[9] lists one interesting example for which the slope of the isochronal curve was 1.00 for rates of flow less than 800 mcf per day; for larger rates of flow, the slope was 0.859. The variations of the performance of the hypothetical well with time are similar to the data for actual gas wells by Cullender[9] and the recent Bureau of Mines tests.

These similarities and differences between actual well performance and performance calculated theoretically are significant. The equations on which the above theoretical calculations are based depend on several assumptions that are not rigorously true in actual gas flow. Some deviations from these assumptions are capable of correction in field tests (for example, supercompressibility). One major assumption is that the flow follows Darcy's law. Correlations of the theoretical data with actual field data indicate that deviations from Darcy's law may be a major factor contributing to the low values of slopes of isochronal curves in actual field tests.

The hypothetical flow-after-flow back-pressure curves have slopes from 0.948 to 0.955. These results indicate that complicated transient conditions in a reservoir may cause part of the deviations of such back-pressure curves from unity. This has been demonstrated with actual gas wells by Binckley.[3] However, the hypothetical back-pressure curves in no instance showed the wide deviation from unity that have been reported in actual tests. Rawlins and Schellhardt[15] summarized the result of 850 back-pressure tests. Of this large number of back-pressure curves, 88 percent had slopes between 0.6 and 1.2; 60 percent had slopes between 0.6 and 0.9. Several workers have shown that gas flow in systems involving porous media may deviate from Darcy's law.[7,10,13,14] Some have concluded that gas-well performance indicates that flow in gas wells also may deviate from viscous flow (that is Darcy's law).[6,8,16] Correlations of the above results tend to corroborate these conclusions.

ACKNOWLEDGMENT

The author is indebted to R. V. Smith, natural gas engineer formerly with the Bureau of Mines, Bartlesville, under whose supervision this investigation was initiated, and to H. N. Dunning, physical chemist, Bureau of Mines, Bartlesville, for assistance in preparing the manuscript.

SYMBOLS LIST

- h = formation thickness, cm.
- K = permeability, darcys
- P_a = bulk av. reservoir pres., atm.
- P_o = initial reservoir pres., atm.
- P_s = pres. std. conditions, atm.
- P_w = wellbore pres., atm.
- P_r = cumulative pres. drop for unit rate of production
- Q = well production, std. cm.^{3}/sec.
- $\bar{Q}$ = dimensionless flow rate
- r_r = reservoir radius, cm.
- r_w = well radius, cm.
- t = time, sec.
- μ = viscosity, cp.
- φ = porosity, fractional
- τ = dimensionless time group, defined in terms of well radius
- Θ = dimensionless time group, defined in terms of reservoir radius

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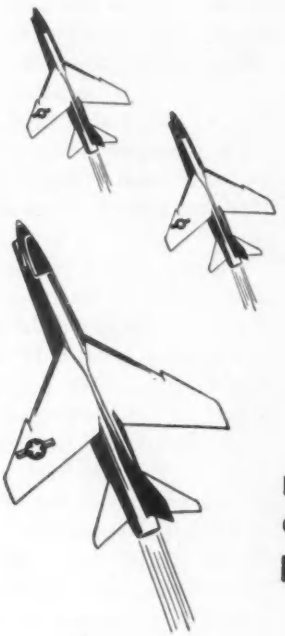

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Dual Concentric Tubing Strings Designed For Corrosion Control

Inhibitor injected into the annulus of two concentric tubing strings may be the answer for corrosion control in dual gas-distillate wells.

By Perry R. Hillegeist, WORLD OIL Staff

SUNRAY MID-CONTINENT OIL COMPANY, Warren Petroleum and Buffalo Oil Company, with Sunray Mid-Continent as operator, recently completed the Zora L. Smith 1, a dual gas-distillate well in the Ridge field, ten miles west of Lafayette, La. This is believed to be the first dually completed well employing concentric tubing strings for corrosion control.

The well is located on the north edge of the Ridge field that has five single completed gas-distillate wells and one dual completion. The field produces from five gas-distillate reservoirs.

Sunray Mid-Continent's Smith 1 was drilled to test the north boundary of the Ridge field and the deep zones across a fault from other sands in the field. After drilling to a total depth of 13,074 feet, the operator found the lower sands non-commercial and plugged back to 10,475 feet for completion in the upper Discorbis 10,130-10,135 and the lower Discorbis 10,390-10,404 feet. The upper and lower zones had recorded shut-in bottom-hole pressures of 4645 pounds and 4740 pounds, respectively.

To control corrosion in gas-distillate wells, operators have attempted

Warm Up Flow Line Freeze Ups...
Eliminate Surface Heaters...Reduce
Pressures to Safe,
Workable Limits With OTIS
BOTTOM-HOLE
REGULATORS
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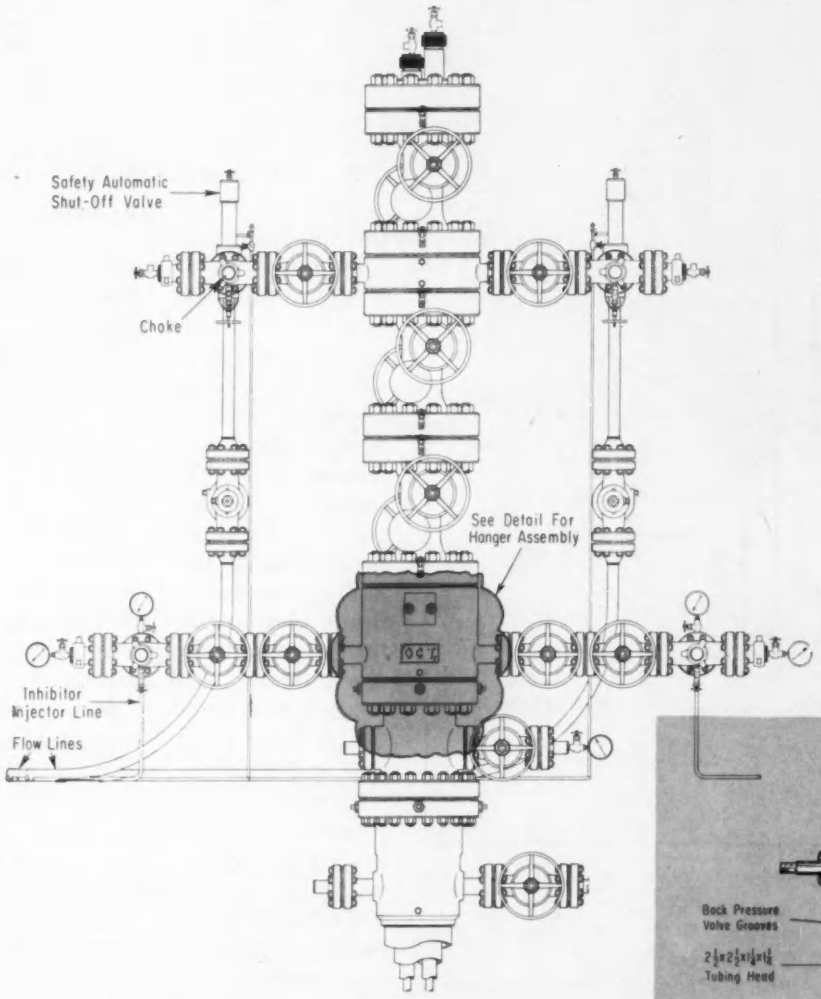
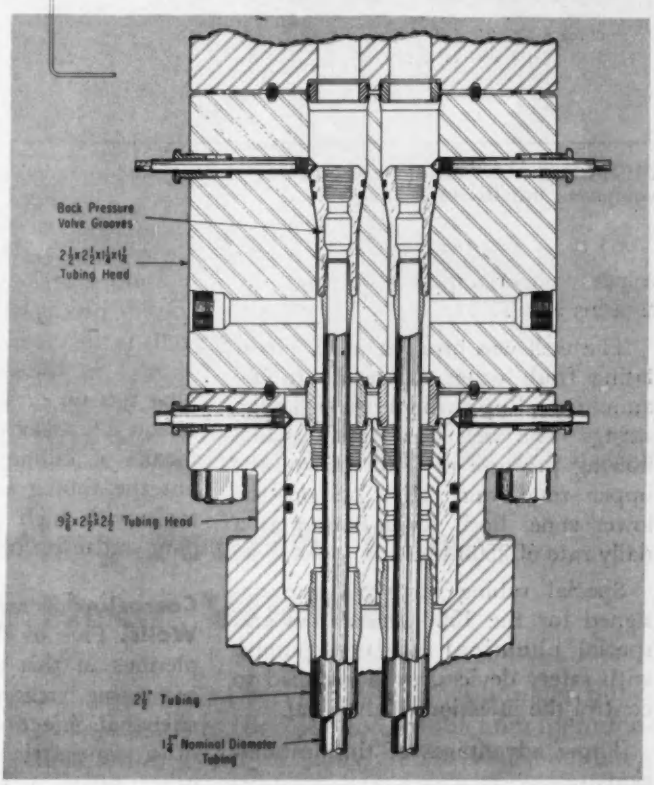


FIGURE 1—These drawings show wellhead equipment installations on Sunray Mid-Continent Oil Company's et al Zora L. Smith 1. Specially designed tubing hangers for the four strings of tubing illustrate a typical example of close cooperation between operator and manufacturer in solving problems of the industry.

Wellhead equipment drawings courtesy Oil Center Tool Company, Houston

Detail of hanger assembly ▸



chemicals into the tubing have helped to some extent in combating this corrosion.

Although for the past two years concentric tubing strings have been used in single zone completions to control corrosion, a unique installation has recently been completed with two concentric strings designed for chemical injection for corrosion control in a dually completed well.

To combat corrosion and to provide for killing the well, operator installed dual 2⅞-inch O.D. tubing strings with 1¼-inch nominal diameter plastic coated tubing strings inside. The plastic lined strings will reduce corrosion problems, friction losses, wax accumulation and serve as the production string.

A special christmas tree was required for the dual 2⅞-inch N-80 and the 1¼-inch strings. For completion attempt, plugs were drilled and the hole cleaned out to 10,405 feet (through perforations). Production packers were set at 10,161 feet and 10,095 feet and the parallel concentric strings run into the hole. A plastic coated blast joint was run opposite the perforations in the upper zone on the long string of 2⅞-inch tubing. After running the 2⅞-inch strings and nippling up the hanger flange, the 1¼-inch strings were run, the

to design better equipment and develop new techniques.

Gas-distillate corrosion is attributed to: the organic acid content of produced hydrocarbons, salt water production, the generally high velocity of fluid in the tubing and the carbon dioxide, usually present in produced gas that goes into solution with water condensation. This corrosion usually occurs at the place where water condenses in the tubing and is usually more serious in the upper portion of the string where the pressure and temperature drop is greatest.

In an attempt to alleviate this condition operators have used various means of chemical injection in an attempt to protect the lower portions of the tubing. Injection of chemicals into the tubing when the well was closed in and the placing of stick

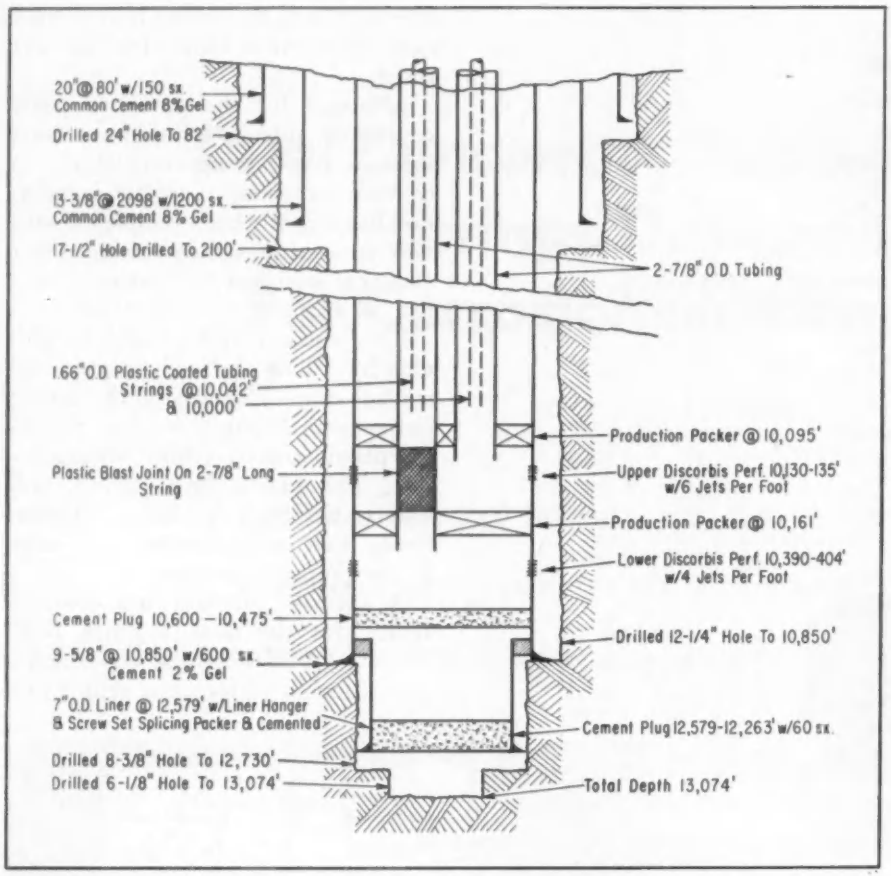

20"@ 80' w/150 sx.
Common Cement 8% Gel
Drilled 24" Hole To 82'
13-3/8"@ 2098' w/1200 sx.
Common Cement 8% Gel
17-1/2" Hole Drilled To 2100'
2-7/8" O.D. Tubing
1.66" O.D. Plastic Coated Tubing
Strings @ 10,042'
& 10,000'
Production Packer @ 10,095'
Plastic Blast Joint On 2-7/8" Long
String
Upper Discorbis Perf. 10,130-135'
w/6 Jets Per Foot
Production Packer @ 10,161'
Lower Discorbis Perf. 10,390-404'
w/4 Jets Per Foot
Cement Plug 10,600 – 10,475'
Drilled 12-1/4" Hole To 10,850'
9-5/8"@ 10,850' w/600 sx.
Cement 2% Gel
7" O.D. Liner @ 12,579' w/Liner Hanger
& Screw Set Splicing Packer & Cemented
Cement Plug 12,579-12,263' w/60 sx.
Drilled 8-3/8" Hole To 12,730'
Drilled 6-1/8" Hole To 13,074'
Total Depth 13,074'

FIGURE 2—Downhole graph showing drilling and completion data and subsurface equipment installations.

upper hanger nippled up and the tree installed.

The well was brought in by circulating fresh water down the tubing annulus and up through the 1¼-inch strings. The well was tested with a flowing pressure of 2965 psi on the upper zone, and 3194 psi on the lower zone. Both zones flowed at a daily rate of 2500 Mcf.

Special tubing hangers were designed for the 1500 series tree, and special chemical injection pumps, with safety devices, were installed to control the injection of chemical.

Three advantages of this installation are:

- Inhibitor can be pumped under pressure to the bottom of the well insuring inside protection to the 2⅞-inch tubing with inside and outside protection to the 1¼-inch production string.
- Easy means of killing the well.
- If the 1¼-inch tubing string becomes damaged, the 2⅞-inch string can be used for temporary production and well killing.

Another serious problem facing operators producing high pressure gas wells in this area is the accumulation of wax in the tubing. Once a wax plug sets up in a single tubing string set on a packer there is no available means of killing the well. Cleaning out the tubing string with wire line tools with high pressures below the plug can result in serious problems.

Corrosion Treatment On Other Wells. Five of the single zone completions in this and adjoining fields are being treated for corrosion by chemical injection into the annulus of a concentric tubing string. The other seven wells in this area are treated for corrosion control by pumping into the tubing with a concentrated mixture of two to six gallons of inhibitor mixed with one barrel of kerosine or diesel fuel when the well is shut-in. The well is allowed to remain shut-in for 4 to 6 hours, allowing the inhibitor to settle. This batch treatment is repeated weekly. A sample of the produced fluid is taken twice a week and analyzed for the iron content in the produced water. The iron content is to determine the correct amount and type of chemical necessary for treatment.

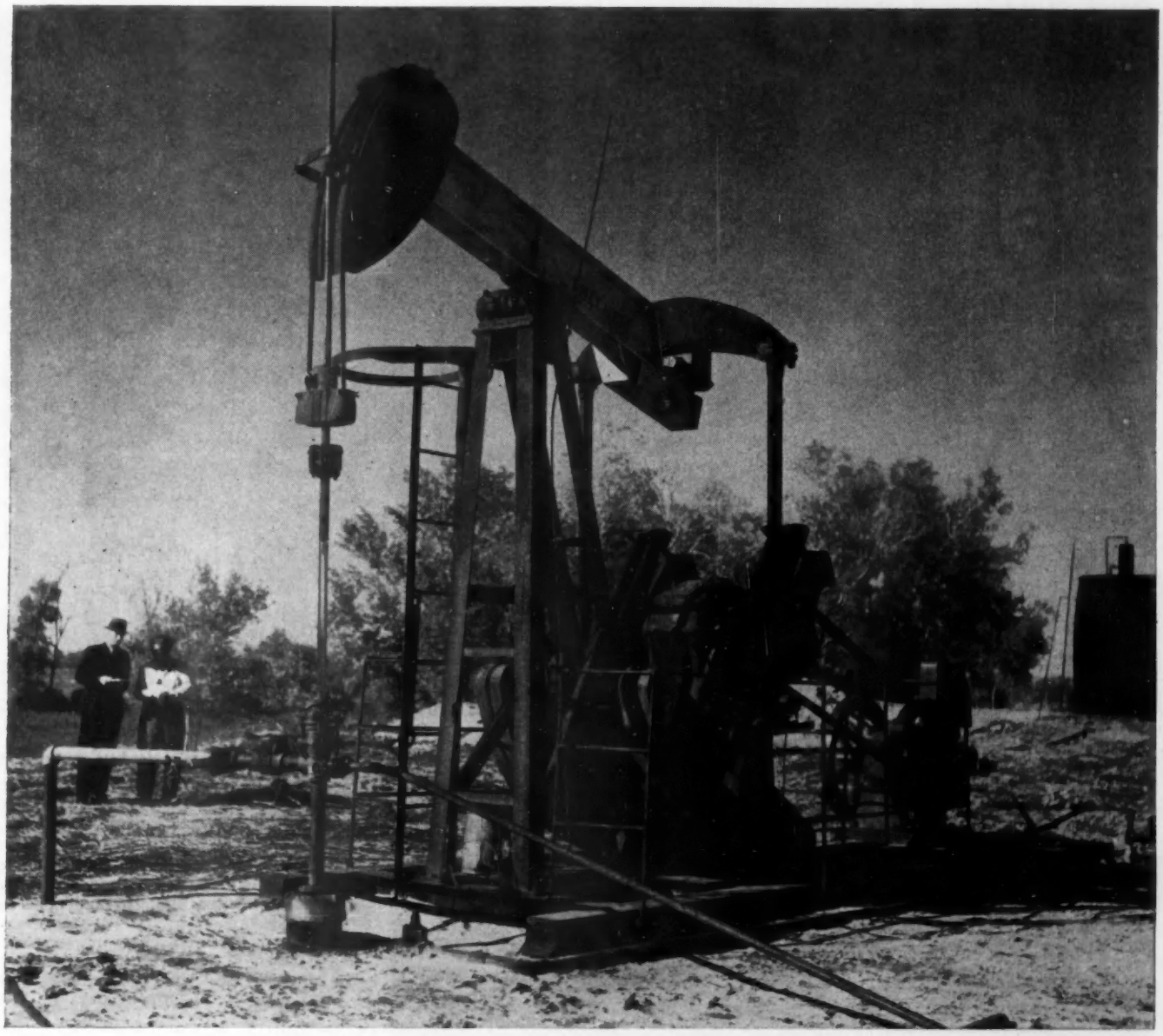
Wells treated by batch injection have shown only slight corrosion. Surveys were run after the wells had been treated for about 12 to 18 months.

This ability to inject chemical into the annulus under lower pressures than the actual flowing pressure is possible due to the hydrostatic head in the annulus being greater than the hydrostatic head in the 1¼-inch flow string. On a particular well, it was six weeks before chemical returned through the 1¼-inch string. An injection rate of 80 gallons per day was started by mixing one quart of organic film forming type chemical with five gallons of kerosine and injecting it into the annulus at 9800 psi. A future plan to trace the chemical return more accurately is to use organic dye in the chemical, creating a cloudy mixture that could be detected more easily. Some completions, treated in this manner, have showed chemical return in four days.

Several safety features are employed to inject chemical in this manner. The chemical injection pump is fed by an 80 gallon tank, designed by company personnel. This type chemical pump can reach pressures of 20,000 psi. Therefore, it was necessary to design safety features to prevent excessive pressure in this range from building up. In the event of plugging, it would be possible to burst a tubing string or injection line.

Valve Safety Hook-Up. To operate these safety features, the company uses a pilot control box with a three-way pilot control valve to vent gas and bleed off pressures whenever a pre-determined setting is reached. In addition automatic shut-off valves are installed on each flow wing so that if the flow line or sales line pressure were to fall below a predetermined setting, the well would automatically shut-in.

The chemical volume tank is 36 by 24 by 24 inches. The measuring stick in the top of the tank indicates to the pumper at any time how much fluid has been pumped into the well. A constant agitation of the chemical is necessary. This is accomplished by rolling the bottom of the tank with approximately 40-50 psi on the input



"46" Rods Completing Fourth Year In 3350-ft Well Near Wichita

How's this for dependable service? A string of Bethlehem ¾-in. "46" sucker rods is rounding out its fourth year of pumping duty at Well No. 1 of the Wolfe Lease, operated by Branine & Holl, Wichita, Kansas.

The 3350-ft well is producing approximately 100 bbl of water and 20 bbl of 34-gravity oil daily from the Arbuckle formation. The pumping unit, a Bethlehem 57DA—12 SP, uses a 42-in. stroke, at 18 spm.

The Bethlehem "46" Sucker Rod is carefully made of nickel-molybdenum steel, and is both normalized and tempered. It is a quality rod in every way, one you can always count on to provide long, economical service in heavy-pumping duty.

In addition to the "46" rod, Bethlehem manufactures other types of alloy sucker rods, enabling you to choose rods best suited to any given fluid condition. We also produce a complete line of sucker rod accessories.

For complete data about Bethlehem sucker rods and companion products, all you need do is get in touch with your Bethlehem sucker rod distributor.

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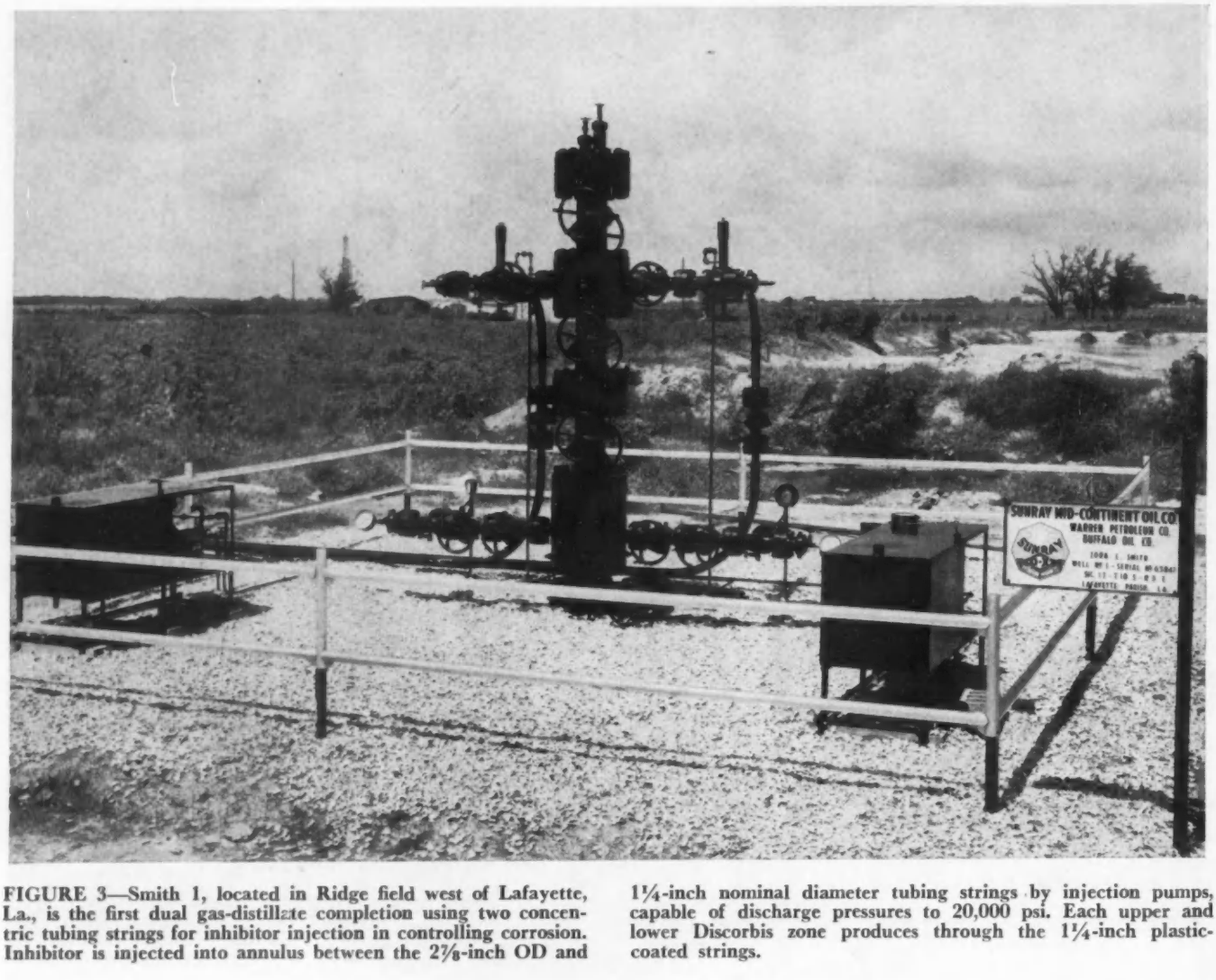


FIGURE 3—Smith 1, located in Ridge field west of Lafayette, La., is the first dual gas-distillate completion using two concentric tubing strings for inhibitor injection in controlling corrosion. Inhibitor is injected into annulus between the 2⅞-inch OD and 1¼-inch nominal diameter tubing strings by injection pumps, capable of discharge pressures to 20,000 psi. Each upper and lower Discorbis zone produces through the 1¼-inch plastic-coated strings.

line eliminating any settling out of the chemical from the kerosine.

The injection pump's gas supply line, from the low pressure separator is regulated at a pressure of 40 to 50 psi. The gas from the regulator goes to the agitation line and also to another regulator, controlling inlet pressure to the pump.

The discharge pressure of the pump, operating with a discharge ratio of approximately 250/1, is controlled with the inlet pressure and by use of the pilot control valve. Discharge pressure is constantly recorded against the bourdon tube in the pilot control box and is also hooked up to the three-way valve. The three-way control valve is a unique feature of this inhibitor injecting system, consisting of:

- A suction or input gas supply valve
- A valve to the vent line
- A valve connected to the bourdon tube in the pilot control box connected to the discharge side of the pump.

The wellhead installation has a 2-inch check valve and a 2-inch choke nipple with a ⅛-inch positive choke installed in the chemical injection line; if the ½-inch extra heavy injection line were damaged to the extent of causing a leak, the well could not flow back with destructive force from the high tubing annular pressure. Each flow line is equipped with one 2-inch automatic safety shut-off valve set to close if the line fails or if sales line pressure drops below a predetermined setting. Thus, if the flow line broke or low temperature extraction unit discharge pressure dropped below this setting, the well would shut in automatically.

Initial chemical injection pressure on the No. 1 Smith will be 3650 psi, the present shut-in wellhead pressure. The pilot control box will be set to shut-off supply gas to the pump at 4000 psi discharge pressure. The ½-inch extra heavy chemical injection line has been tested to 14,000 psi. The high pressure single zone completions in this area with 2900 series wellhead installations have pre-determined discharge setting of the chemical pump at 10,000 psi, for maximum safety.

Conclusion. This means of corrosion control on a dual well, worked out between the manufacturer and operator, has solved a special problem. The specially designed hangers for each tubing string is a typical example of close team work between operators and manufacturers in the industry.

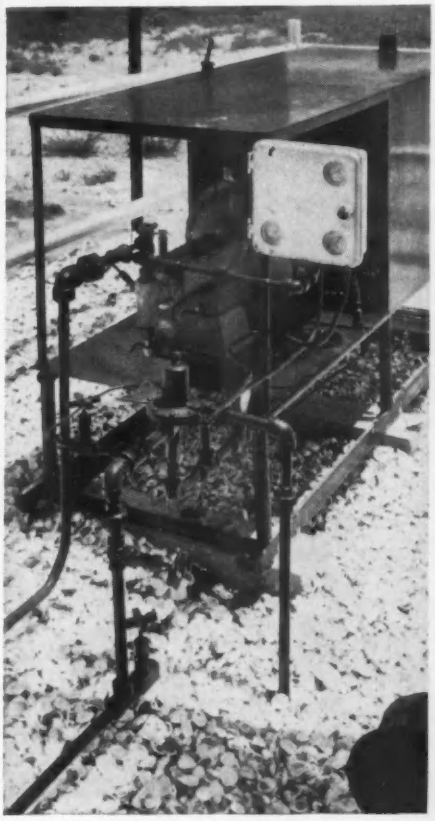


FIGURE 4—High-pressure, skid-mounted portable tank and pump with valve-regulator safety hookup designed by company personnel. Safety features prevent excessive pressures from building up in the annulus in event of plugging, which could burst a tubing string or injection line. A pilot control box, shown near top of photograph, a three-way pilot control valve, in front of the pump, and the two regulators behind the pump control the pump's discharge pressure. Whenever a predetermined discharge pressure is reached, the supply gas is shut off and pressures are bled off through vent line.

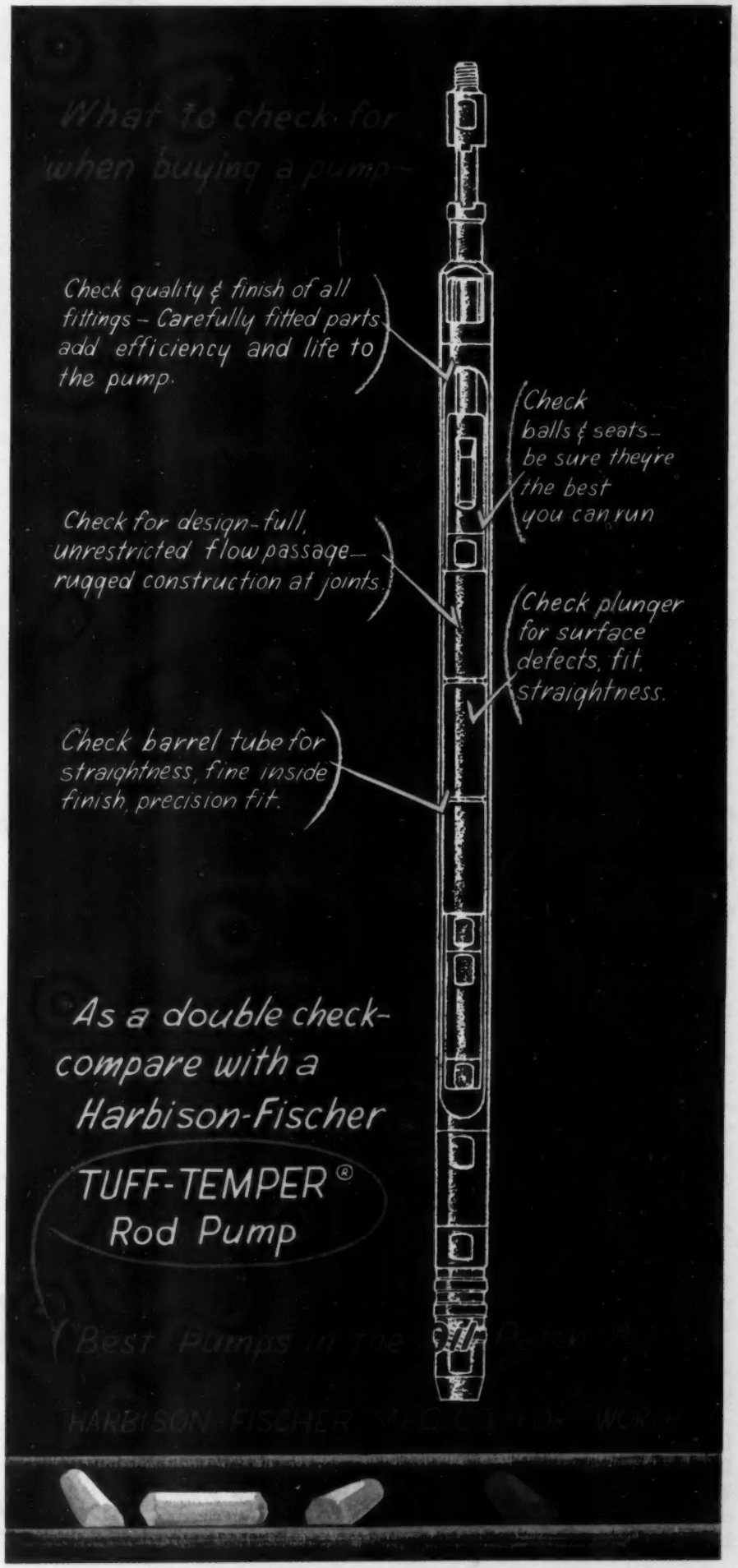
Although this method of inhibitor injection into a concentric tubing string annulus is not new and has been used for several years, this type installation for dual production is the first of its kind.

Advantages offered over a conventional installation should give other operators the needed know-how to employ similar installations in combating corrosion problems.

In summarizing this unique corrosion control method, it has provided a means to get inhibitor to the lower portions of the tubing string; provided a way to kill the well and a means of temporarily producing through the outside string, should the inner tubing fail.

ACKNOWLEDGMENT

The author wishes to express his appreciation to the engineering staffs of Sunray-Mid-Continent Oil Company, Lafayette, La., and Oil Center Tool Company, Houston, for supplying data.


What to check for when buying a pump—
Check quality & finish of all fittings – Carefully fitted parts add efficiency and life to the pump.
Check balls & seats – be sure they're the best you can run
Check for design-full, unrestricted flow passage – rugged construction at joints.
Check plunger for surface defects, fit, straightness.
Check barrel tube for straightness, fine inside finish, precision fit.
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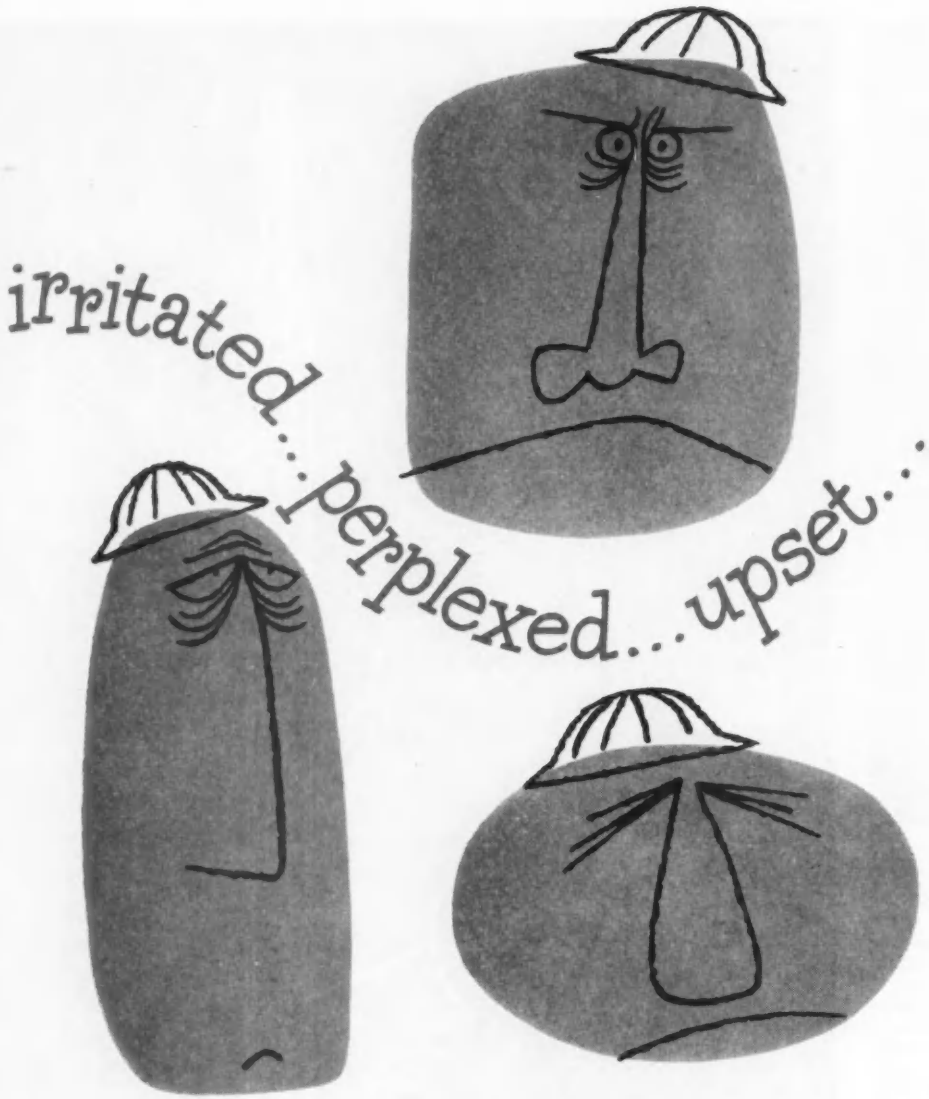

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European quarters of the seismic camp on the Aworra River in western Papua.

'Copters Triple Output Of Exploration Party in Papua

Air transportation also cuts operational costs of what may be the largest seismic field venture in the world.

By A. B. Malone
The British Petroleum Company, Ltd.

WITH THE PASSING of years, the search for oil has to be extended into remote parts of the world where problems of access are more acute and more expensive. Such difficulties, however, never have been allowed to impede for long the progress of geophysical exploration. The ingenuity of the geophysicist, coupled with that of his colleagues in the field of transportation, has resulted in the continued development of new types of vehicles designed to overcome access problems.

Practically all forms of terrain can be worked today with some comfort and a useful degree of speed. The traveler passing over the desert sands of the Middle East frequently is confronted with a bewildering succession of wheeltracks; the air traveler over the foothills of the Canadian Rockies is impressed by bulldozer trails which seem to divide the virgin forest neatly into townships; the marsh buggy and similar vehicles carry the geophysicist and his equipment through tropical swamp and Canadian muskeg; and other types make possible the crossing of deep snowfields, even the crossing of Antarctica.

However, there are parts of the world where the conditions still present a challenge to the designer of special forms of mechanical transportation. Such an area is the western part of Papua, where The British Petroleum Company Ltd., Vacuum Oil Company Ltd. and Oil Search Ltd. of Australia have pursued their exploration for oil for more than 18 years.

Perhaps the greatest obstacle to the introduction of a satisfactory form of mechanical transport is the variability of the terrain. A typical seismic traverse might commence in deltaic mud, covered with nipa palm and mangrove, rise through sago and grass swamps and finish in the bush and tall timber of the rain forest. And in the forest itself abrupt changes of elevation, varying from a few feet to a few hundreds of feet are not uncommon.

There are no roads, and jungle tracks are practically non-existent. The only "highways" are the rivers, along which may be seen occasionally a few dugout canoes or larger vessels. Because of the high rainfall, the rivers frequently become swirling brown torrents carrying debris, and they are infested with crocodiles and made dangerous to river craft by hidden snags. At spring tides, twice in every 24 hours a bore, or tidal flood, races up some of these rivers—an experience that can be frightening to those in a small river craft in midstream, especially at night when the bore's approach is heralded by a roar and its onset is marked by the sudden appearance of a wall of water rushing out of the darkness.

Of course, geophysical camps are located whenever possible, on high ground adjacent to a river bank. The rise and fall of the rivers can be considerable, and a flooded camp is no fun. All the building is in native style, with bamboo or saplings used for supports and palm leaves for thatching. Floors of all buildings are invariably supported on stilts. Ample building material usually is available in the vicinity, and, once the clearing in the forest has been made, building by the experienced Papuan natives is rapid.

Accommodations for the party members are cool and comfortable, and the center of social activity is a combined mess, game room and reading lounge. In one case, these were housed all under one roof measuring perhaps 40 feet by 50 feet or more.

The personnel of a conventional seismic party may comprise about 20 Europeans and 250 Papuans, and about 10 tons of food per month are required. Explosives, too, are required

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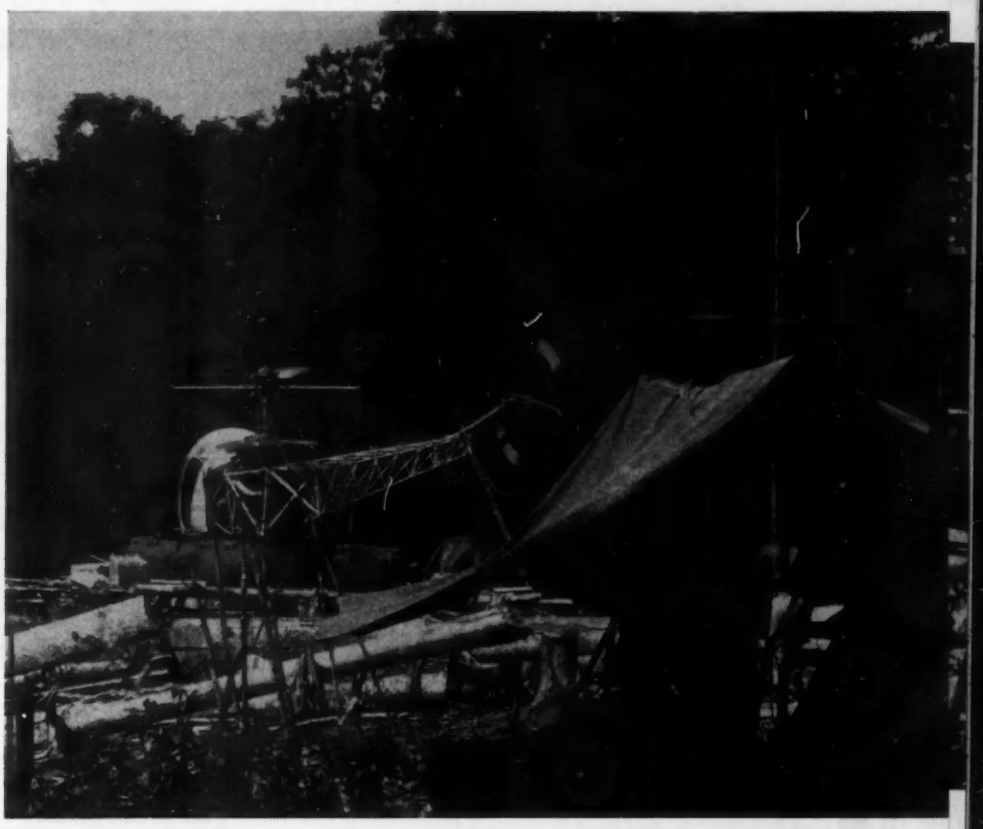
in considerable quantity and may average another 10 tons.

For a camp on the river, this presents no problem, but when it is inland, it has been found cheaper and faster to deliver supplies by air. Important items of a fragile nature are dropped by parachute, but many others, such as bulk supplies of rice and flour contained in strong double hessian sacks, are allowed to drop free.

The recovery is in excess of 90 percent; the main losses being through packages lost in the tangle of felled trees used as a dropping ground or in the surrounding jungle. Dynamite, too, is delivered by air. Occasionally, a parachute will fail to open, and it can be stated with some confidence that 60 percent gelignite can be dropped 300 feet without exploding.

The most popular air-drop is that of the "freezer"—the regular supply of frozen fresh meat and other fresh food. Each camp now is equipped with a deep-freeze unit, and it is seldom that the men have to fall back for long on their supplies of canned basic foods.

A large base camp usually remains in the same location for many months, and sorties of a few days or a few weeks duration are made by the cutting gangs, surveyors, drillers, observers, and shooters. During these sorties, the men live "rough"—usually with a canvas fly or a tarpaulin stretched between trees for shelter from the rain. There is regular radio communication between the central camp and the various parties in the bush. Supplies of food, dynamite and other requirements are carried out by gangs of native porters whose maximum load is 40 pounds.

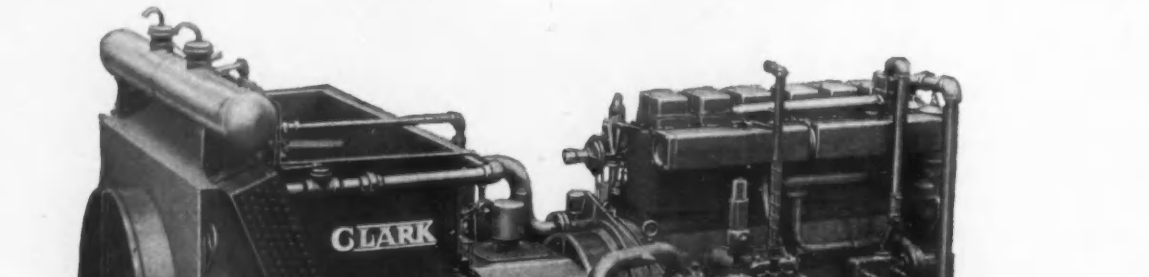


Problems are lessened when the observers' camp can be supplied by helicopter.

A survey party member crosses a creek at Wassi Kussa, Papua. Note handrail on the left.

In parts of the forest a cutting gang may clear only 1000 feet of narrow track in a day, so that preparation of a seismic traverse is a slow business. For long-range refraction work shots up to two tons are required, and the movement of four tons of explosive out to a distance of only eight miles from the base camp may occupy 100 carriers for a week. Trekking through the forest can be arduous, particularly when the ground is badly broken by gullies and the occasional crocodile-infested creek. "Wait-a-while" thorns try one's temper and there are repeated stoppages to burn off, with a lighted cigaret, one's cargo of leeches.

Shot-holes are drilled either with



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hand augers or with lightweight portable outfits. For refraction work, holes are frequently sprung with a small charge before loading.

Operations sometimes are interrupted by flooding. In places an annual rainfall well over 300 inches has been recorded and, from intermittent records, it is believed to be much higher in the foothills. Camps have been inundated, equipment destroyed and field work brought to a standstill for months because of extensive flooding of the area of operations. But it is the local flash flood that brings the most danger and produces most of the anecdotes of Papua—as of the party leader who spent the night sharing the ridge-pole of his tent with a large python, 30 feet above what had been a dry creek bed the previous day. Or of another camp injudiciously placed on the outside bend of a river, where camp personnel were busily trying to ward off large floating trees, acting like battering rams against their flimsy houses, while far out on the main torrent, the observers were drifting down past the camp in hastily improvised bamboo rafts.

Operations are also hindered by the unsuitability, in some respects, of the Papuans for the work. With his bows and arrows in his hand, nose and ears pierced for shell or bone ornaments, and Bird of Paradise plumes in his fuzzy hair, the Papuan is picturesque. As a carrier, the Papuan performs well.

Forty pounds is a good load to carry over difficult terrain in a trying climate, and being small—usually less than five feet in height and weighing under 120 pounds, he is hardly suited, physically, for this type of work. His sense of balance, however, is wonderful. As he carries an expensive piece of equipment over a thin swaying sapling felled to make a bridge over a creek, the skill of the Papuan is to be applauded.

In such adverse circumstances, it is not surprising that the average output of a refraction party rarely exceeds 10 miles a month. The observations have to be made in great detail, as the low velocity weathered layer is extremely variable in its thickness, and a very close check has to be kept on it. Differences amounting to as much as 0.1 second have been recorded in weathering times between stations 1600 feet apart, the station interval being 800 feet.

This shot hole is being drilled with a lightweight portable unit, instead of a hand auger which is used sometimes in Papua.

Here, cable is being laid on a seismic traverse. The dense Papuan rain forest is in the background.

Some time ago three helicopters were attached to one refraction party to improve output. The operation has been a marked success. For safety reasons it is necessary to clear a patch in the jungle the size of a football field at every mile along the seismic traverses. This is accomplished by

Photos courtesy The British Petroleum Company, Ltd.

This is one of the canoes used on Kuru creek for transporting supplies.

gangs of Papuans equipped with mechanical handsaws.

Surveyors, observers, drillers, and other key field personnel and equipment can be transported to the scene of operations in hours now instead of days. The relief from the arduous trekking has raised morale enormously. A great advantage, also, is that the men on long sorties in the field can share in the "freezer" drops at the main camp, something which before was not possible because of the long time it took to reach them. Supplies and spares of all kinds, including explosives, are flown out from the base camp every day to various field parties.

At first consideration, the utility of helicopters was not obvious. They could lift only 400 pounds from a heliport, and 250 pounds or less from a jungle clearing. Nevertheless, they proved their worth repeatedly. As an example, the task of moving four tons of explosives eight miles, which occupied 100 carriers for a week, could be accomplished by a single helicopter in one day. That such a requirement is not abnormal in large-scale refraction work can best be illustrated by the fact that in one month a single crew used 78 tons of dynamite for 600 records for 68 miles of traverse.

Use of helicopters has tripled output and reduced considerably the cost per mile of observations. Extra personnel required for helicopter crews and mechanics, for the chainsaw gangs and field assistants has raised the total party's strength to 45 expatriates from Europe, Australia and America and 450 Papuans. Almost certainly it is the largest seismic party in the world. It forms, in fact, the second largest "settlement" in Papua.

Recently, the large-scale refraction reconnaissance has been followed by reflection observations with two parties. Needless to say, the operational and the technical difficulties are considerable, and the quality of the records is by no means good. Perhaps the greatest adverse factor with which a reflection party contends is the highly variable weathering previously mentioned, which spoils reflection lineups and make recognition of reflections very difficult.

A first class reflection party is working in Papua under contract, and Frank Perrin, its experienced party chief, admits that though he has had some tough assignments during his career, this is certainly the worst he has struck. However, he and his staff seem to enjoy the life, and they have a tremendous affection for the helicopter which serves them so well.

This is the party which was scheduled to undertake later a waterborne survey of the delta area and of some of the rivers which flow into the Gulf of Papua.

—The End

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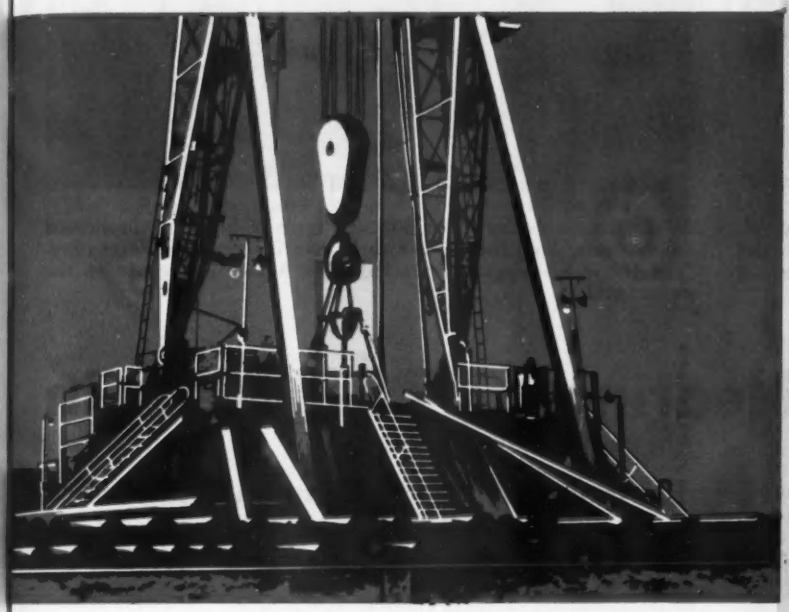

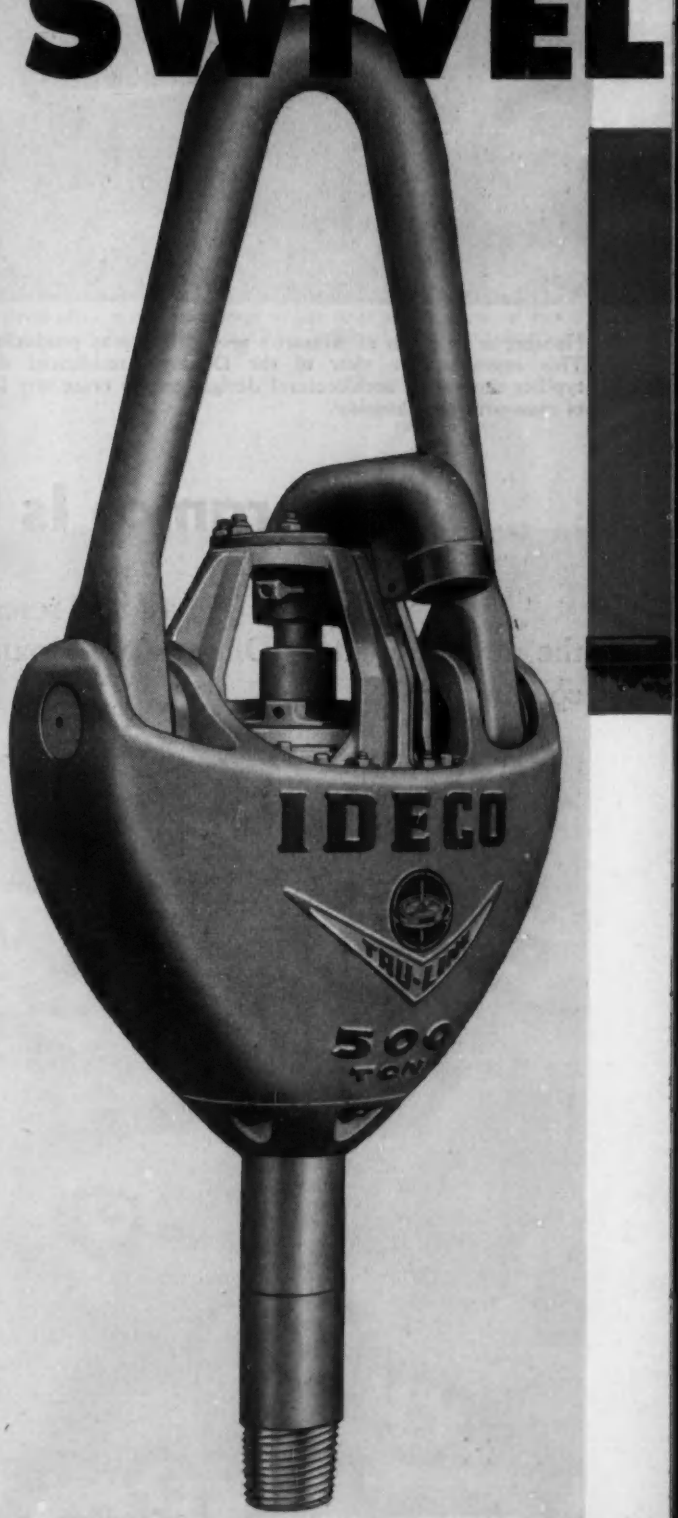

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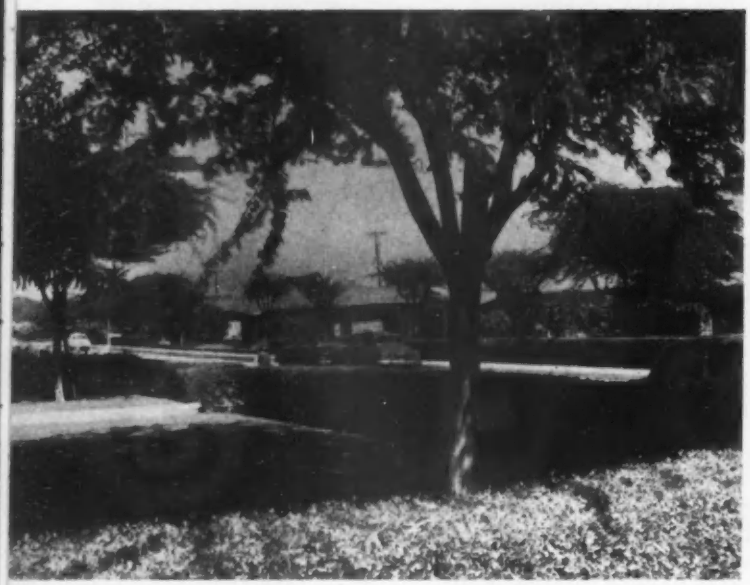


Housing is as much of Aramco's responsibility as producing oil. This representative view of the Dhahran residential district typifies the varied architectural designs which erase any feeling of mass-produced housing.

While the floor plan of the different types of houses is duplicated many times, homemakers use their own ingenuity in decorating. The David Swindigs have included an Arabic coffee pot on the coffee table.

Aramco Is Nearing Its 25th Year in

Discovery of major oil reservoirs almost a quarter of a century ago has led to the development of Dhahran, company headquarters, into an orderly, self-contained community.

As in state-side cities, Dhahran offers its own golf course. While sand traps are the rule rather than the exception on this 18-hole Rolling Hills course laid out on desert sand near Dhahran, golf balls are painted red to stand out against the white sand.

ARABIAN AMERICAN Oil Company in 1958 will celebrate its first quarter of a century in Saudi Arabia. And in those 25 years one of the major oil capitals of the world has emerged from the sandy fastness overlying major underground oil reservoirs characteristic of the Middle East.

Dhahran, a pinpoint on the map of Saudi Arabia, lies almost 2000 miles north of the equator, and serves as company headquarters and administration center for all Aramco activities and the largest of the three principal communities. Abqaiq, 43 miles southwest, is in the heart of one of the largest known oil reservoirs; Ras Tanura, 42 miles north, is the site of the company's 189,000-barrel-a-day refinery and Persian Gulf shipping terminal.

Nine small communities have been added to the operation in the eastern province of Saudi Arabia—Qaisumah, Wari'ah, Nariyah, Safaniya, Abu

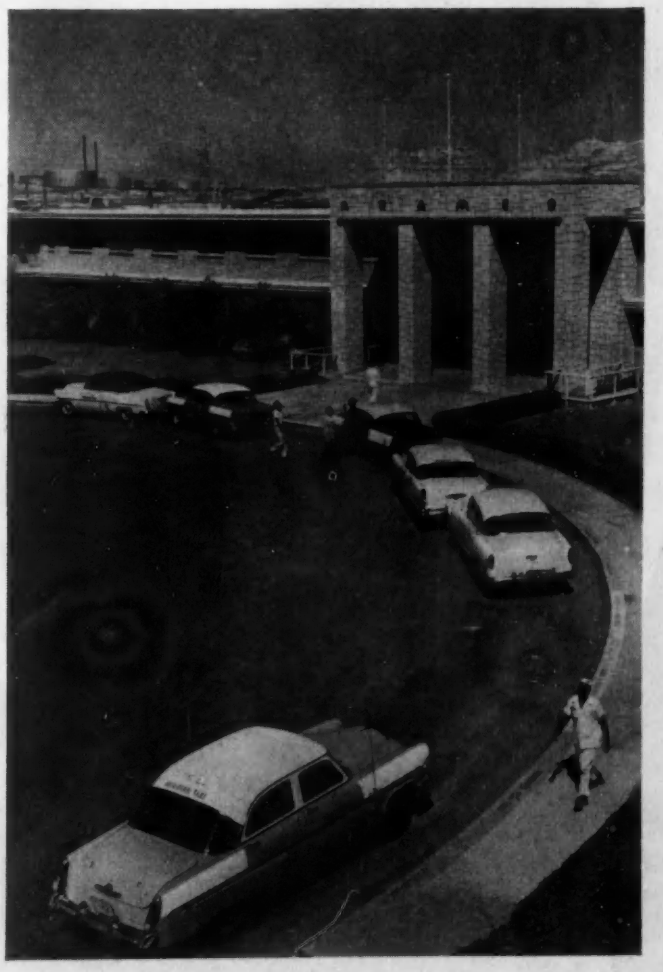
Trips, welcome diversions for housewives everywhere, are available for Dhahran residents. This group, appearing pleased rather than tired after a rail excursion to the suqs, or markets, of Hofuf, is laden with Arabic wares. The railroad car was chartered.

Saudi Arabia

Hadriyah, 'Uthmaniyah, 'Udhailiyah, Haradh, and 'Ubaila.

But it is Dhahran, typically American in aspect, which is the nerve center of this complex oil exploration, drilling, producing, refining, and shipping operation. Residing in a four-and-a-half square mile Senior Staff area are 896 American families and 749 American employes on bachelor status, in addition to Saudi Arabs, Pakistanis, Indians, Palestinians, Italians, Adenese, Sudanese, Dutch and people of other nationalities. Eligibility to live in the Senior Staff area depends on job classification, not nationality.

Almost 25 years ago, the community site was a sand-swept jebel, or rise; today it is a self-contained community, offering recreation, entertainment and a life similar to that found in any large U. S. community —from bowling to baseball, from fine arts to flower shows.



Aramco's administration building was erected in 1949. Rising behind the building is a portion of the Dammam dome where Aramco first discovered oil in commercial quantities in 1938.

Pictures Continued on Page 245.

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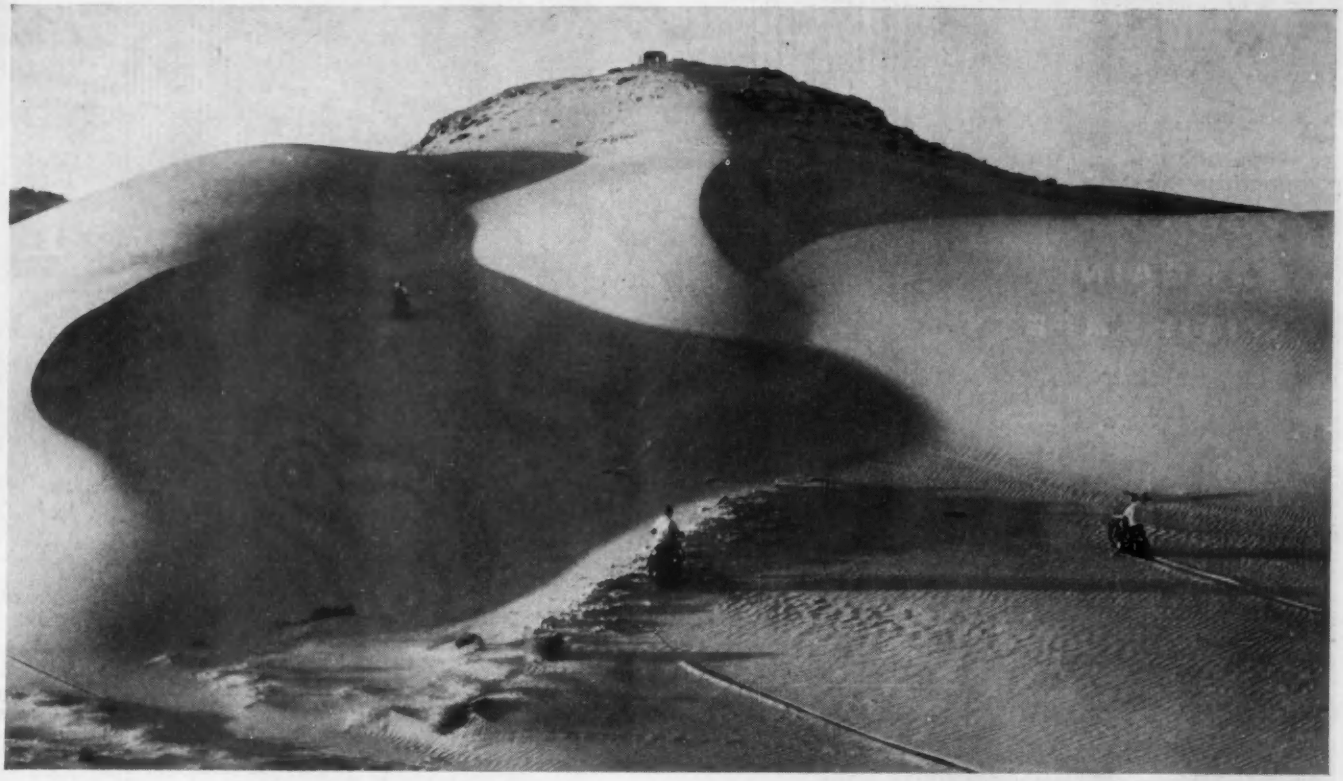
ARAMCO NEARING 25TH YEAR IN SAUDI ARABIA . . .



These sand dune cyclists turn the terrain to their advantage as they defy gravity in roaring up the sides of 60-foot, crescent shaped sand dunes near Dhahran. When conditions are most advantageous, after winter rains, the cyclists make jumps from small sand dunes like ski jumpers.

Included in the wide variation of sports interests is the Corral at the Dhahran Hobby Farm, which is a branch of the international Arabian Horse Association. One of the Corral's major scheduled activities is a Gymkhana in which members display their horses and horsemanship.

Dhahran, like oil communities the world over, is governed time-wise by a whistle. On off days or after work, many residents turn to the sea for pleasure. Preparing for a fishing trip is Max Carter of Aramco. The long, ominous looking instruments he is checking are minnow gigs.

This 240,000-pound steam drum, built by Combustion Engineering for a large generating plant, is here being hoisted 120 feet into position by strong wire rope. It's a striking example of how . . .

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What's Happening

among WORLD OIL MEN

H. C. Hose

H. B. Nichols

H. C. HOSE has been named a director and executive vice president of California Texas Oil Company.

•

H. B. NICHOLS has been named a director and executive vice president of California Texas Oil Company.

•

L. M. BROADWAY has been elected deputy chairman to the board of C. C. Wakefield & Co., Ltd. He will hold this office in conjunction with his position as managing director. Broadway, who runs the expanding Wakefield group of 21 companies, was promoted to the board in 1947 and has been managing director since 1954.

L. M. Broadway

•

Creole Petroleum Corporation announced that all directors of the company were reelected and also that H. A. COTTIN and J. F. HOLMES have been appointed assistant comptrollers of the corporation. Cottin has had 22 years of service with Creole in Venezuela. Holmes joined Creole in 1948 as a procedures accountant. At the present time he is coordinator of procedures, statements, audits and electronic data processing planning at the company's office in Caracas. Directors of the corporation reelected are Messrs. GEORGE L. BURR, W. L. BUTTE, L. CADE, H. W. HAIGHT, H.A. JARVIS, CHARLES LEET, L. E. LOWRY, R. E. MAYS, H. A. METZGER, DR. S. VAZQUEZ, H. J. WRIGHT and DR. G. ZULOAGA.

Officers of the corporation reelected by the board are president, Haight; executive vice president, Jarvis; vice presidents, Metzger and D. E. STINES; secretary, E. J. MUNDY, JR.; treasurer, J. H. McCUTCHAN; comptroller, J. E. ANDREWS. The board also made the following reappointments: assistant comptrollers, R. PRINCE and H. D. SCHERSTEN; assistant secretaries, G. J. BERKEL, JR., C. F. LINDSLEY, JR., and E. T. McNAMARA; assistant treasurers, C. J. BARRIENTOS, A. E. BECKER, JR., MUNDAY, JR., and B. M. OWEN.

•

A. G. FARMILO, chief chief geologist for Calvan Consolidated Gas Co. Ltd. and Western Leaseholds Ltd., Calgary, has been promoted to management assistant. His duties chiefly will be associated with liaison between non-operated interests of the company and their obligation divisions. Farmilo is the immediate past president of the Alberta Society of Petroleum Geologists.

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J. B. SAUNDERS has been elected as senior vice president of Kerr McGee Oil Industries, Inc. Saunders, president of Triangle Refineries, Inc., of Houston, will continue in that capacity. He also is vice president of Texas Eastern Transmission Corp., Atlas Processing Co., Inc., and Southern States Barge Line, Inc.

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A. B. BROWN has been elected president of Richmond Exploration Company, the South America exploration and producing subsidiary of Standard Oil of California. Brown previously served in Indonesia as managing director of Caltex Pacific Petroleum Company.

•

ARTHUR R. SMITH, former Calgary alderman, member of the provincial legislature and recently elected Progressive Conservative member for Calgary South in the House of Commons in Ottawa, has accepted a post as executive assistant with Pacific Petroleum, Ltd.

He resigned as executive assistant with Anglo American Exploration Ltd. to take the new job.

•

JOHN H. W-WILSON was named manager of Canadian Association of Oilwell Drilling Contractors on April 1, 1957. He was educated in England and went to Canada in 1952 after leaving the Anglo-Iranian Oil Company when political upheaval occurred in Iran.

John H. W-Wilson

•

C. W. HAMILTON, vice president, Gulf Oil Corporation, and chairman of the board, Gulf Eastern Company, London, England, planned to retire July 1. Hamilton is a veteran of more than 41 years of service with Gulf, having joined its staff in 1916 as chief geologist for the Mexican Gulf Oil Company.

•

J. E. BAILEY, chief petroleum engineer for the Southern division of Tidewater Oil Company, has been sent by his company to Iran to serve two years as senior technical adviser to the National Iranian Oil Company.

Bailey is joining the Iranian concern under a two-year loan agreement between Tidewater and National Iranian. Tidewater is a member of a Consortium having an interest in the Iranian company, and each member of the group has agreed to send technical personnel to participate in the operation.

A civil, mechanical and petroleum

engineer, Bailey has been with Tidewater since 1937. Prior to that, he was chief petroleum engineer for the Texas Railroad Commission in Austin. He has been in the oil industry since 1917. He is a registered professional engineer, and a member of the American Petroleum Institute, American Institute of Mining and Metallurgical Engineers and National Association of Corrosion Engineers.

•

W. H. PINCKARD has retired as chairman of California Texas Oil Company after 40 years of service. He will be succeeded by W. F. BRAMSTEDT, formerly president of Caltex since 1950. A. J. SINGLETON, executive vice president, has been elected president, succeeding Bramstedt.

W. H. Pinckard

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ELINOR L. MARTIN has been named assistant secretary of Standard-Vacuum Oil Company at the White Plains, N. Y., headquarters. Miss Martin has been with the company since 1946. She also served Stanvac in Japan.

•

J. PATRICK D'ARTOIS has been appointed resident manager in charge of all operations of The Ohio Oil Company of Guatemala. The company operates several oil and gas concessions and unit areas recently issued by the government of Guatemala. The concessions total about 1½ million acres in the Departments of Alta Vera Paz and El Peten, Republic of Guatemala.

The company, a subsidiary of The Ohio Oil Company, holds an interest in the concessions in association with other oil companies.

D'Artois will be responsible directly to F. J. FUNK, vice president of the Guatemala organization and manager of foreign production for The Ohio Oil Company.

A. H. PETSCH has been appointed exploration manager of the organization, responsible for oil and gas exploratory operations.

E. A. GRAHAM has been named controller, in charge of accounting, banking, payroll, purchasing and office services.

D'Artois, previously an attorney in The Ohio Oil Company's Shreveport, La., division, has for the past year been assigned to Ohio Oil's Foreign division as a representative for Conorada in Guatemala. A graduate of Centenary College Law School, Shreveport, he joined Ohio Oil's Legal department at Shreveport in 1931. He has been associated with the Louisiana and Shreveport Bar Associations, Mid-Continent Oil and Gas Association, American Petroleum Institute and other legal and petroleum organizations. Before studying law, D'Artois for two years was superintendent of sugar cane cultivation for LaRomana Central in the Dominican Republic.

Petsch's geological experience in Latin America began in 1920. A graduate of the Missouri School of Mines, he joined Ohio Oil in 1928. He was district geologist at Amarillo, Texas, before assignment to Conorada in 1955.

Employed in January 1955, Graham advanced through accounting positions in the general office at Findlay, Ohio, and at Tulsa, Okla. He is a graduate of Evansville College and has taken courses in financial management at Dartmouth Graduate School.

•

LANDON B. DERBY has been named assistant general manager of the Foreign Operations department of The Texas Company in New York City. Derby has been with Texaco since 1927 and was assistant general manager of foreign sales before his recent promotion.

Landon B. Derby

•

FRED C. BOUCKE has been named manager of the Eastern Hemisphere staff of Standard Oil Company of California. Boucke has been with SoCal since 1937 and has heretofore served as assistant to the president with responsibility for Eastern Hemisphere matters.

Arabian American Oil Company has elected GARRY OWEN vice president. Owen will represent Aramco in discussions on company matters with the Saudi Arab government. He will make his headquarters at Dhahran, Saudi Arabia. Owen is a lawyer who started with Standard Oil Company of California in 1939, transferring to Aramco two years later.

Garry Owen

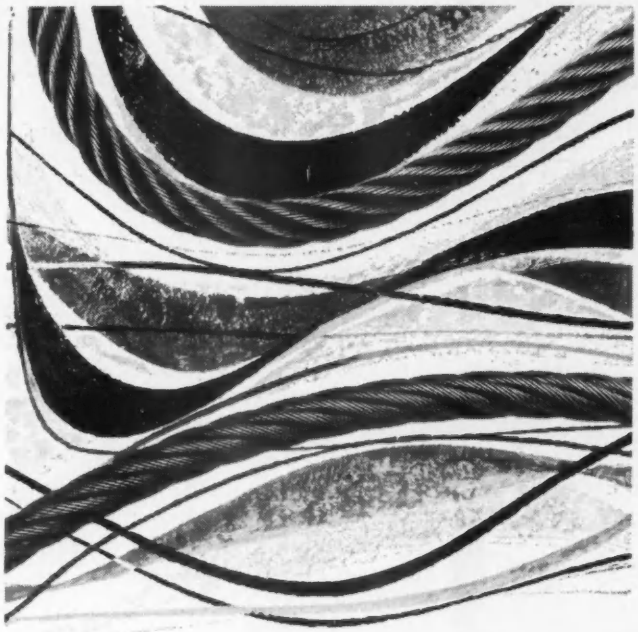
•

ARTHUR A. (DUKE) CURTICE has been named president and general manager of Signal Exploration Company, foreign subsidiary of Signal Oil and Gas Company. Signal Exploration is the operator in Venezuela in a joint venture with subsidiaries of Standard Oil Company (Ohio), Hancock Oil Company, and Pure Oil Company. Curtice's headquarters will be in Caracas.

The election of Curtice will enable GARTH YOUNG, who has been president of Signal Exploration since its start in 1955, to return from Caracas to his post in the U. S. as vice president and head of Signal Oil and Gas Company's Foreign department.

Curtice, an internationally eminent geologist and petroleum engineer, was associated with HERBERT HOOVER, JR., and GLEN RUBY from 1942 until 1952, heading the firm of Hoover, Curtice and Ruby, S. A. This firm carried on work for the Corporacion de Fomento de la Produccion of Chile which resulted in the discovery of the first oil field in Chile. In 1944 they acted as technical advisors to the Prime Minister of Iran, and similarly aided President Dutra of Brazil in 1947. The firm also managed the campaign of petroleum exploration and drilling in Naval Reserve 4 on the arctic coast of Alaska for the U. S. Navy.

During 1945 and 1946, Curtice was petroleum consultant to the Government of Peru, and wrote the preliminary draft of a petroleum law and regulations of Peru. From 1949 to 1954, he was president of Conorada Petroleum Corporation, and from 1954 to 1956 has been a consultant on Venezuelan oil problems.



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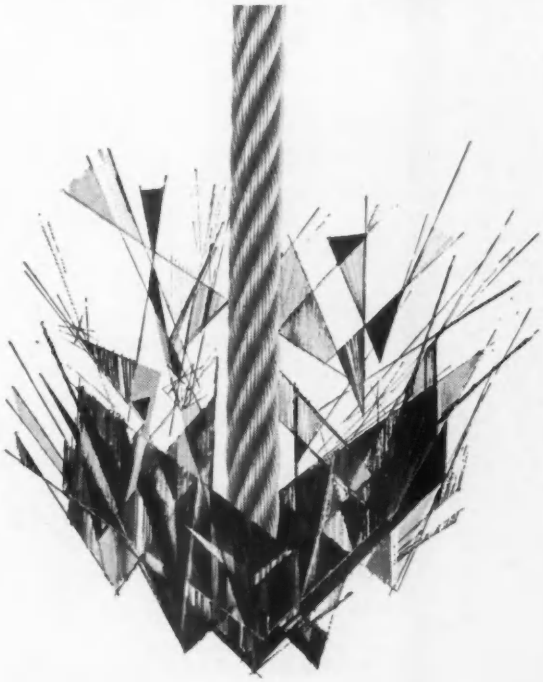

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AUSTRIA: Official crude production figures put total output for the first half of 1957 at 11,016,707 barrels, or 60,865 barrels daily, about 678,800 barrels, or 3750 barrels daily, less than during the same period of 1956 . . . The Austrian Mineral Oil Administration is operating four exploration crews, equipped with U. S. and Russian equipment, in the Western Marchfeld concession area . . . Lack of gas pipe lines has forced the shutting down of 17 wells producing both oil and gas . . . Rohoelgewinnungs AG. has spudded in Wegscheid 1 well in the Upper Austria/Salzburg border area in Western Austria . . . Russia has waived the need for Austria to export 678,800 barrels of compensatory oil for the second delivery year as well as the 1.3 million barrels scheduled to be delivered during the third delivery year.

NATIONAL IRANIAN OIL COMPANY

179 FRANCE AVENUE

TEHRAN, IRAN

1st September, 1957

The National Iranian Oil Company hereby informs all interested persons and Companies that, in accordance with the provisions of the Iranian Petroleum Act of July 31st, 1957, any inquiries, requests for information, or proposals of any nature whatsoever in connection with the performance of petroleum operations in Iran must be addressed direct to:

The Chairman of the Board of Directors,

NATIONAL IRANIAN OIL COMPANY,

Avenue France,

Tehran, Iran

Any communication made through other channels shall have no effect.

BOLIVIA: Yacimientos Petroliferos Fiscales Bolivianos has completed and dedicated its new four-inch oil pipe line from Camiri field to Santa Cruz. With a capacity of 3000 barrels daily, the line will serve a topping plant at Santa Cruz . . . Gulf Oil has unloaded a drilling rig at its base point, Boyuibe, on the Yacuiba-Santa Cruz railroad, and was drilling for water with a light rig. Water is expected to be a problem at its scheduled Mandeyapecua well . . . Gulf is operating six geological parties.

CANADA: Vulcan Oil Ltd. will acquire assets of Newclare Oils Ltd. and will buy some oil, gas and other assets from Siscoe Mines Ltd. and New Davies Petroleums. Name of the consolidated company will be Siscalta Oils Ltd . . . A natural gas discovery with a potential of between 3 Mmcf and 5 Mmcf daily has been made by Fargo Oils Ltd. of Calgary ten miles south of the limits of Sibbald field, one from which Trans-Canada Pipe Line Ltd. will draw gas supplies.

FRANCE: Cities Service Oil Company, under an agreement recently signed with Societe de Prospection et Exploration Petrolieres en Alsace and Compagnie Franco-Africaine de Recherches Petrolieres in Paris, became the first U. S. oil firm to take official steps to explore in the Sahara desert. The three companies planned to seek immediate exploration permits in the Sahara.

GERMANY, EAST: State Agency VEB Erdoel und Erdgas Gommern reports the discovery of oil at 5249 feet near Osterwieck.

GERMANY, WEST: Mobil Oil AG.'s wildcat Molbergen-West 1, drilled about two miles northwest of the Molbergen oil field in South Oldenburg in a consortium with Gewerkschaft Brigitta, has found oil in the Middle Kimmeridge between 4915 feet and 4954 feet. Further drilling is scheduled to determine the discovery's commercial significance.

"MR. GUS II" goes to Grand Isle

'Mr. Gus II," C. G. Glasscock Drilling Company's mammoth new marine drilling rig . . . equivalent in size to five U. S. destroyers . . . and most expensive mobile offshore unit ever built . . . may be the first to operate in open water depths to more than *150 feet*. Weighing *9,000 tons*, with drilling equipment and supplies, "Mr. Gus II" looked massive on the maiden voyage to Grand Isle . . . yet not too large for completely safe control by powerful G & H tugs GRAMPUS, MARLIN, and JUNO manned by thoroughly experienced offshore towing crews.

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HUNGARY: With a 1957 crude production goal of about 4.8 million barrels, output during the first quarter amounted to about 1.3 million barrels, according to Budapest reports.

INDIA: The plan to have exploration activities conducted by French parties in Jaisalmer reportedly has been cancelled due to the unfavorable foreign exchange situation.

PAKISTAN: Tidewater Oil Company reportedly has sought to negotiate with the government to obtain oil exploration permits . . . Pakistan Petroleum Ltd.'s first successful gas well of East Pakistan, Sylhet 3, which was completed late in July, has a calculated open flow potential of more than 100 Mmcf daily.

PANAMA: United Fruit Company, New York, has acquired oil exploration rights covering more than a million acres in the Chiriqui Province on the Pacific Coast. The concession originally was granted to Cataract Mining Corporation, which turned it over to Time Petroleo, S.A., a subsidiary of Time Petroleum Company, which, in turn, conducted the negotiations with United Fruit.

PERU: The second well drilled by the German-Peruvian consortium Elwerath-Deutsche Erdoel AG.-Wintershall-El Oriente in a concession east of the Andes mountains, which is 1500 feet southeast of the discovery oil well Maquia 1, flowed under test at a rate of about 260 barrels daily. Further drilling was described as necessary before Maquia's commercial value could be evaluated.

POLAND: It took a Polish drilling crew from June 24, 1955, to Jan. 8, 1957, to drill what is claimed to be the nation's deepest well—Swidnin 2, which reached a reported 10,670 feet and was drilled as a deep structural hole.

RUMANIA: The new natural gas pipe line under construction from Gura Sutii (Transylvania) to Bucharest was expected to be completed during October. The pipe line project resulted from the current effort to replace solid fuels use as much as possible with gas.

RUSSIA: Production during the first half of the year amounted to 290,532,000 barrels, or almost 1,605,150 barrels daily, which is tantamount to an increase of 17 percent over the comparable period of 1956. During this period, 1957 natural gas output was about 318 billion cubic feet, or 41 percent greater than during the first six months of 1956 . . . Concentrated exploration activities are under way in the Kazakhstan S.S.R. area of the Aktjubinsk plains, with field parties conducting operations up to the Ili River.

SAUDI ARABIA: Initial wildcat test of central Saudi Arabia, currently being drilled by Arabian American Oil Company about 80 miles west of the company's extensive Ghawar oil field, is scheduled for completion in early 1958. No concession has been granted covering the exploration area and, while several U. S. companies have expressed interest in the oil rights, Aramco reportedly has preference in the acquisition of concession rights in the area . . . Aramco has on order what is described as the world's first "miniature" mobile platform designed specifically for use with a platform tender in offshore drilling. Chief

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We do not provide information on oil securities.

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difference in operation of this platform and the self-contained units is that virtually all supplies and crew accommodations will be contained on a tender.

SICILY: Well 3 in the Gela field, operated by Ente Nazionale Idrocarburi, the Italian oil monopoly, has been put on production and assures—with Well 1—a daily output of about 1400 barrels.

TURKEY: Bolsa Chica Oil Corporation is conducting additional detailed geological work on an inland block of 370,000 acres about 30 miles northwest of the Garzan oil field . . . Bolsa Chica holds five licenses covering about 612,000 acres.

VENEZUELA: Newly-discovered oil production of Superior Oil Company of Venezuela in Lake Maracaibo will be shipped through La Estacada terminal of Talon Petroleum, C.A., on the east side of the lake opposite Maracaibo city . . . First newcomer to the lake area to produce oil, Superior recently completed two large wells with a combined capacity of about 10,200 barrels daily on its 7774-acre concession in the middle of the lake . . . Creole Petroleum Corporation will install overhead power transmission lines from the Lake Maracaibo shore to a spur nine miles out in the lake to supply electrical power for pumping operations and gas reinjection.

Consolidated Cuban's Well Is Brought In As Producer

Consolidated Cuban Petroleum Corporation has completed its Consolidated Cuban 4 as a producing well in the Bacuranao-Cruz Verde field. This well is the 11th producer brought in by Consolidated in this area. There are 18 producers in the field: 11 are owned by Consolidated or its subsidiary, Petroleos Cruz Verde, S. A.; three are the property of Morro Castle Petroleum Company; one of McCulloh Drilling Company; three of Salomon Oil Enterprise, S. A.

The new well flowed 600 barrels the first two days. It is closed in as much as possible and present production is coming largely through leaks in the casing head. The present development of the field dates from the discovery well, Cruz Verde 1, which reached production on Jan. 21, 1955.

Consolidated recently acquired the 3040-acre Ensign concession, in the Bacuranao area, and planned to drill a 3000-foot test. The company also will drill a 6000-foot test on properties it holds in Motembo field in Las Villas, with work scheduled to start this fall.

Sparks Group Obtains Concession in Jordan

J. W. Sparks and associates have taken over the second oil concession to be granted in the Hashemite kingdom of Jordan by the Jordanese government. The concession originally was granted J. Zimeri, Guatemalan industrialist, who reportedly has successfully negotiated with the Sparks group, which will assume the operation and obligations of the concession. Zimeri reportedly retained an overriding royalty interest.

The concession covers one-third of the total area of Jordan. Another one-third of the country previously was granted to Edwin W. Pauley, U. S. oil man.

J. W. Sparks is a Texas oil operator and drilling contractor.

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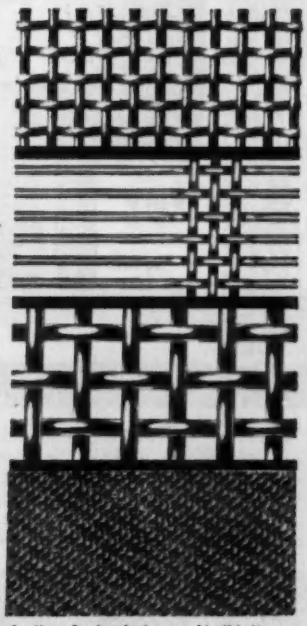

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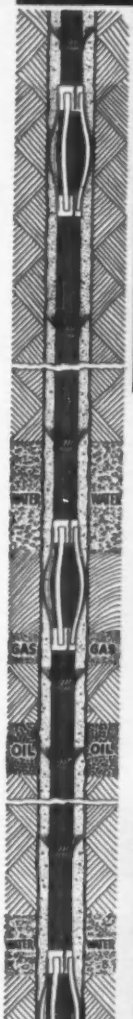

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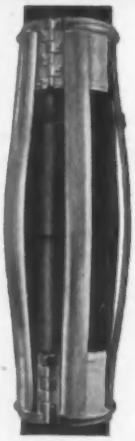
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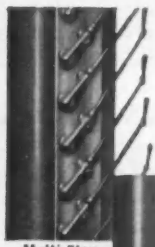
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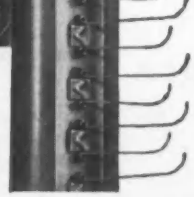
B and W Rotating Scratchers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Mexico's Cortines Reveals Progress In Oil Production, Offshore Operations

Two highlights of Mexico's oil industry progress during the 12 months ending September 1 were described recently by President Ruiz Cortines in his report to the nation as:

- The first discovery in Mexico of oil production in Jurassic formations.
- Continuation of offshore operations in the Gulf of Mexico.

Other developments revealed by the President in his address included:

1. Drilling—during the 12 months ending September 1 a total of 373 wells were completed with total footage amounting to 2,427,820 feet, tantamount to an average per-well depth of 6508 feet. During the preceding 12 months, 372 wells were completed with total footage recorded of 2,096,-450 feet, equivalent to an average per-well depth of 5635 feet.

The completion of 98 exploratory tests led to the discovery of 16 new oil or gas fields in the States of Tamaulipas, Nuevo Leon, Veracruz and Tabasco.

2. Reserves—increased more rapidly during the 12-month period than at any time since 1901, reaching 3302 million barrels. That is tantamount to a net increase of 416 million barrels of crude and 118 million barrels (equivalent) of gas.

3. Supply and demand—75 million barrels of oil were delivered to domestic markets during the period, 11 million barrels more than during the previous August 31-September 1 period. A total of 32.4 billion cubic feet of natural gas—3.9 billion cubic feet more than during the previous 12 months—was delivered to domestic markets. Exports amounted to 19 million barrels of crude, 6 million barrels less than 1955-1956. Oil imports totaling 14 million barrels were required to supply immediate needs of areas distant from production centers.

4. Pipe Line—The 308-mile Tampico-Monterrey crude pipe line was completed. Plans to handle liquid gas and to ship products of the Atzapotzalco (Mexico City) refinery were completed.

AMOA and 3 Austrian Provinces Sign Pact

The final agreement on the relation between the Oesterreichische Mineraloelverwaltung A.G. and the three provinces connected by location or interest with AMOA—the Lower Austria province, the Vienna Municipality, and the Styria province—was signed in Vienna by the Austrian Mineral Oil Administration and provincial agencies.

The agreement provides for:

- AMOA to pay $3,864,000 to NIOGAS, which, in return, will hand over the exploitation and exploration concession of the East-Austrian oil fields to AMOA.
- AMOA to deliver to NIOGAS, for a period of 10 years, 14.1 billion cubic feet of natural gas per year at 50 percent of the official price.
- The Federal Government to pay for AMOA crude deliveries to the Soviets at 100 percent of the cost level in 1960.

Beginning from 1958, AMOA is to receive federal payments for part of the crude deliveries, these payments being granted in the form of compensation for taxes or for exploitation fees.

2 Pan Am Subsidiaries In Caribbean Renamed

Two subsidiaries of Pan American Petroleum Corp. operating in the Caribbean area have taken new names.

Jamaican Stanolind Oil Co. has become Pan Jamaican Oil Co. Pan Jamaican holds prospecting licenses on the entire island of Jamaica and its tidelands. Its first two exploratory wells were dry and abandoned. Its third, West Negril 1, was scheduled to begin drilling in June.

Venezuelan Pan American Petroleum Corp. has become Pan Venezuelan Oil Co. Pan Venezuelan has been and is conducting surface geological and geophysical operations in Eastern and Western Venezuela, chiefly in varying joint account operations with other oil companies active in the country. At the last awarding

D9 WITH KELLY RIPPER (left) prerips unexpected rocky soil for ditcher. The Cleveland Ditcher (right) which follows is powered by a dependable Cat D339 Engine. The ditcher is cutting a depth of 65 inches at about 28 feet per minute.

NATURE put R. H. Fulton & Co. to the test during a 241-mile natural gas pipeline job across the Mojave Desert from Needles to Newhall, Calif.

Rock cropped up unexpectedly. Unseasonable high winds held up welding and painting, at times backfilled the ditch. Sand made maintenance of a firm ditch difficult. There were three river crossings and rugged mountainous terrain. But Fulton, with the help of its big Caterpillar spreads, overcame each obstacle, lowering in an average of 5,000 to 6,000 feet a day with a one-day high of 16,000 feet.

The 30-inch line is part of a $33.5 million joint expansion program of Southern California and Southern Counties Gas Companies. It will provide an additional 227.6 million cubic feet of gas per day.

Here are some of the problems Fulton encountered and how they were overcome:

ROCK—This occurred in stretches of presumably sandy material from 9 to 24 inches below the surface. By using huge Kelly Rippers mounted on the giants of the spread—CAT* D9 Tractors—a great deal of shooting was eliminated. The D9-Kelly Ripper combination preripped the rocky soil for the ditcher.

Because of danger of rock damage to pipe in backfilling, the entire length is padded on the bottom of the ditch and top of the pipe. Two Cat No. 977 Traxcavators* and a Crosse Ditch Padder side-mounted on a D8 were used for the padding operation. A D7, working with a No. 12 Motor Grader, backfilled.

WIND—Unseasonable high winds backfilled the ditch and periodically stopped welding and painting operation. But welding crews set a brisk pace in spite of the winds. Using Caterpillar* Twin Arc-Welders on Athey track wagons pulled by a D7, their best day was 16,200 feet.

MOUNTAINOUS TERRAIN—Rugged Kane Springs Canyon and the Ord Mountains had to be crossed. A D8 and D9 were used to winch a Northwest Backhoe over the steep canyon grade. Later, D9s towed stringing trucks in and out of the mountainous area.

Altogether, Fulton had almost 70 Caterpillar track-type Tractors and Pipelayers at work. In addition there were five Twin Arc-Welders, and dependable Caterpillar Diesel Engines powered cranes, backhoes and ditchers.

When it comes to the tough jobs, pipeliners know there is only one make of equipment designed to produce wherever the pipe takes them. That's why the standard color in fast-moving spreads throughout the world is Caterpillar yellow.

CAT TWIN ARC-WELDERS, mounted on Athey track wagons and pulled by a D7, helped make up for time lost due to high winds in the desert. Best day: 16,200 feet.

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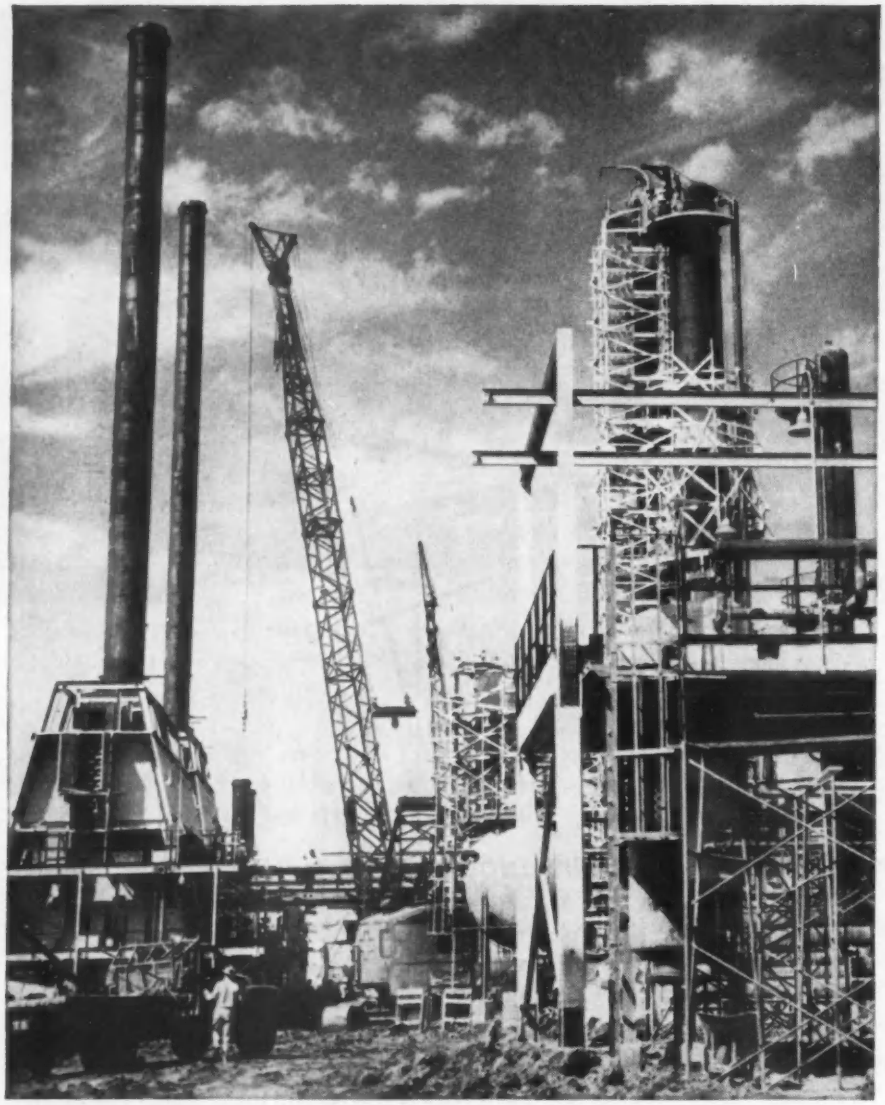

CATS MULTIPLY FAST IN CANADA

Nowhere is Canada's swift industrial progress more striking than in the recent development of its oil refining and petrochemical facilities. Canada's daily refining capacity already approaches 700,000 barrels. New petrochemical plants are rising from coast to coast, to meet the demand for paints, alcohol, ammonia, plastics, detergents, synthetic rubber and other products of petroleum or natural gas.

U. S. executives interested in any branch of the oil and natural gas industry in Canada will find a useful ally, and a prompt, dependable source of information in The Canadian Bank of Commerce. Write or telegraph direct to C. H. Munro, Manager, Petroleum and Natural Gas Department, 309 Eighth Avenue, West, Calgary, Alberta, or to our Business Development Division, Head Office, Toronto 1, Canada.

(*We regret that we cannot advise on the merits of oil or mining securities*)

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of concessions, Pan Venezuelan was the successful bidder for full or undivided interests in several concessions.

The third Pan American subsidiary in the Caribbean, Cuban Stanolind Oil Co., will retain its name for the present. Cuban Stanolind has drilled two dry holes and has announced plans for an offshore venture in south-coastal waters. Cuban Stanolind holds about 16 million acres of concession rights in Cuba and in certain offshore areas.

Canadian Oil, Gas Firms Awaiting Tax Decision

Canadian oil men are awaiting word of results of a brief presented in August to federal government authorities seeking income tax amendments which would eliminate the present disadvantages of Canadian oil and gas firms competing with foreign corporations in Canadian oil and gas development.

Highlight of points stressed in the brief sponsored by the Canadian Petroleum Association, is a demand for institution of the 25 percent depletion allowance of the exploration company's share in gross proceeds of their oil and gas production. The act should be amended, the brief claims, to make more adequate provision for recovery of productive land acquisition costs and to encourage greater development of Canada's oil and gas resources.

Italian Oil Monopoly Aims At Sicily's Industry

It has been confirmed that Enrico Mattei, head of the government-owned Ente Nazionale Idrocarburi, has plans for spreading government control of oil industry operations into Sicily. The Sicilian Regional Government's oil law is one which encourages operations by private capital companies.

However, Mattei has approached Sicilian officials with a detailed proposal for creating an ENI subsidiary in Sicily. The subsidiary, under Mattei's plan, also would operate 25 tankers to be registered in Sicilian ports as well as operating a ship repair service and drydock to be built at Messina.

In return, the Sicilian government would adopt the same mining law now in force in Italy, except for the 15,000-barrel-a-day Ragusa oil field,

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Formed to coordinate branch offices, equipment, and sales set-ups of the former Hillmac Corporation and ACC Diamond Coring, entire facilities of the three well known companies have been integrated, providing the maximum in speed and efficiency for YOU, whatever your location.

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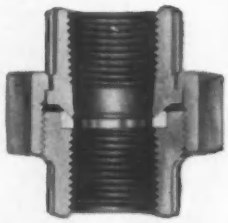

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which is operated by the Gulf Italia Company, and for research permits granted the Esso-Rasiom group.

Meanwhile, the Italian Senate Committee on Industry has approved the new Italian oil bill without changing any of the text approved by Parliament; however, it was felt in Italian oil circles that when the bill is submitted to the Senate, amendments favorable to private capital operations were likely to be introduced.

However, the Italian Cabinet fears that any alteration adopted in the bill would cause difficulties with the Socialists.

The Sicilian Government had issued 43 research permits covering more than 3.3 million acres, of which 39 permits covered slightly more than 3.1 million acres to Italian firms and only four permits, totaling slightly more than 191,500 acres, to foreign firms.

The Italian concessions are distributed as follows:

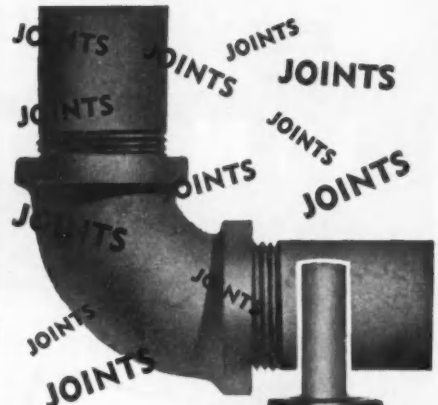
Ente Nazionale Idrocarburi, 892,400 acres; Societa Industrie Chimiche Edison of Milan, 777,475 acres, Societa Montecatini of Milan, 638,130 acres, Societa Snia Viscosa of Milan, 246,100 acres, Compagnia Coris, 202,80 0acres, Societa Mediterranean Oil Company, 191,747 acres; Rasiom-Esso Group, 183,185 acres, CISDA, 160,320 acres; and other small permit holders, slightly more than 44,000 acres.

It has been announced officially that, in Sicily, Ragusa field wells 1 through 7 have proven existence of crude reserves amounting to about 61 million barrels. The remainder of the concession has reserves of an estimated 112,900,000 barrels. According to the Caltanissetta District Mining Office, the cumulative Ragusa output during 1956-1958 should reach almost 8.5 million barrels.

The concession granted to Gulf Italia in the Ragusa zone covers 182,231 acres. Currently, 14 wells are in production in the field. Gulf Italia has completed three dry holes at Giarrantana, Chiaramonte and Ligodia, as well as seismic research work in the Grammichele zone.

Huge Rig in Punjab Operated by Rumania

A 45-ton Rumanian rig has been put into operation on a projected 11,500-foot test well in India's Punjab State. The location, at Jwala-



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mukhi, is in Punjab's northeastern Kangra district, which lies in the Sivalik ranges of the Himalaya Mountains. The drilling site is 55 miles from the railhead at Pathankot.

This exploratory well is the first major step in an expanded project under India's second Five-Year Plan for oil exploration under the auspices of the government. The Rumanian drilling rig was bought for 4 million rupees, and was rigged up at Jwalamukhi by Rumanian technicians. Indian technicians are being trained in drilling techniques as part of the government's project.

The derrick has a load capacity of 300 tons, and is equipped with five 300-horsepower engines. The casing program includes setting 18-inch casing to 300 feet, 14¾-inch casing from 300 feet to 2100 feet, and 10¾-inch and 5¾-inch casing to the projected depth of 11,500 feet.

To reach the location with drilling equipment, a four-and-a-half-mile 24-foot wide road was cut through solid rock by 7000 laborers who toiled for months.

Near the initial test location a second drilling site has been staked out for a rig from Russia. The road to the second site is rapidly approaching completion.

German Company to Join Sardinia Oil Exploration

Wintershall AG., Kassel, together with the government of the semi-autonomous Italian island of Sardinia, have founded a company which is to search for oil and natural gas deposits in the western part of Sardinia. Exploration rights for an area of 3500 square miles covering the western half of the island were granted to the Societa per Azioni Idrocarburi Sardegna (SAIS), in which Wintershall has a majority interest.

As surface-geological conditions in western Sardinia are not yet sufficiently known, SAIS will start with geological mapping, which will be followed by geophysical investigations probably late in 1958 or early in 1959.

Wiag has decided to take part in the exploration for oil on Sardinia, as this island of the Mediterranean is not subject to the regulations of the new Italian Petroleum Act, which is disadvantageous to foreign companies.

Congrats and $25 to Samuel J. Martinez, 1830 East 15th St., Tulsa 4, Oklahoma, for this quip.

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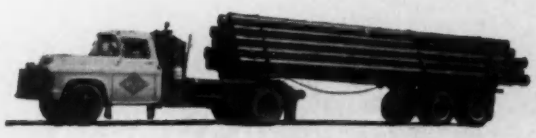
In order to deliver more pipe to our good friend and neighbor, Joe Roughneck, the big, completely integrated Lone Star Steel plant is again being greatly enlarged. Construction of our new open hearth furnace and stretch-reducing mill is in full swing.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.



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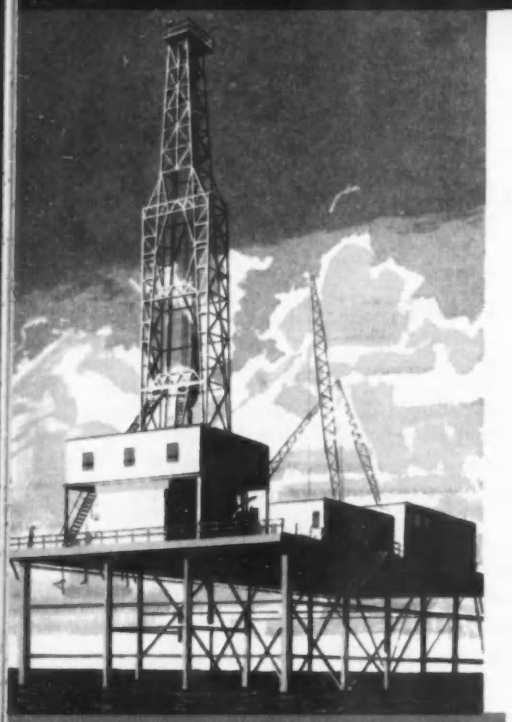
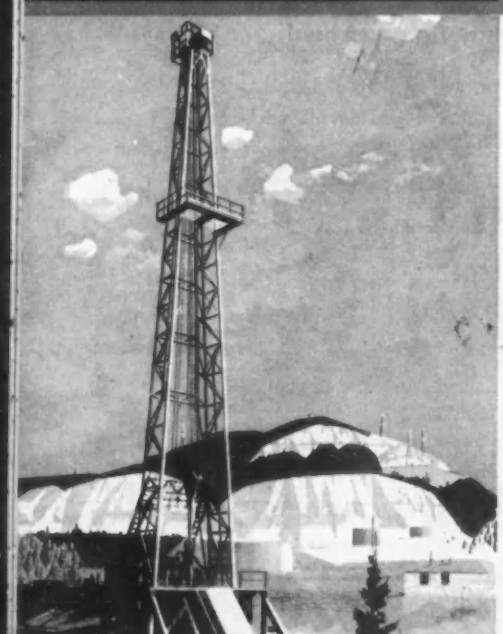
There's a Continental-Emsco Slush Pump rated for your rig..





From portable rigs to deep offshore installations, there's a Continental-Emsco Slush Pump that will give you the volume-and-pressure range to meet your drilling requirements. A wide selection of liner sizes allows you to step-up pressures or volumes *gradually*.. or *fast*, as drilling conditions dictate.

You'll find these pumps are big in performance, low-cost in operation, and that they give you *more horsepower per pound* than any other slush pump.

A strong, rigid, lightweight power end is the result of Continental-Emsco's *Fabriform Construction*, which uses steel plates and special shapes in place of a bulky, heavy, rough casting. This means lower transportation costs and easier field handling.

Lubrication is automatic, since all running parts are flood lubricated by a positive-splash system.. troublesome lubrication and grease fittings are eliminated.

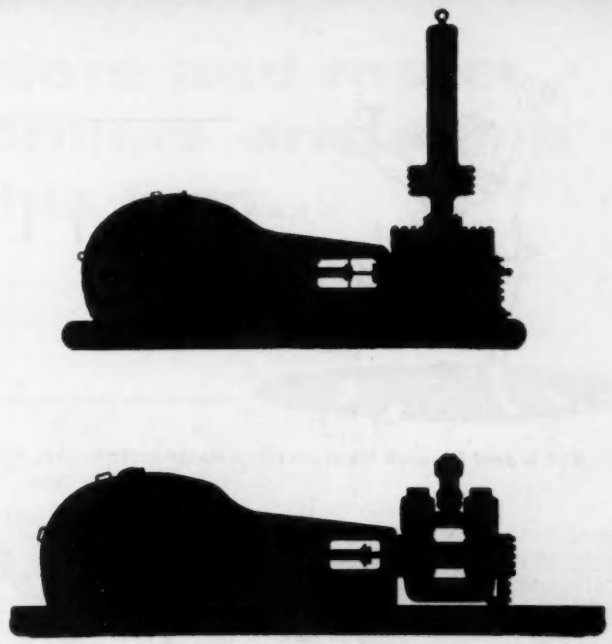
Typical of the simplified maintenance features of these pumps is their patented "exposed" liner construction. Here packing leaks can be spotted immediately.. long before damage can be.. or has been.. done.

..for Shallow Drilling D-175 and D-300

In the 175 and 300 horsepower range, these small pumps can produce the pressures and volumes to match the drilling range of all types of portable rigs . . and save on weight.

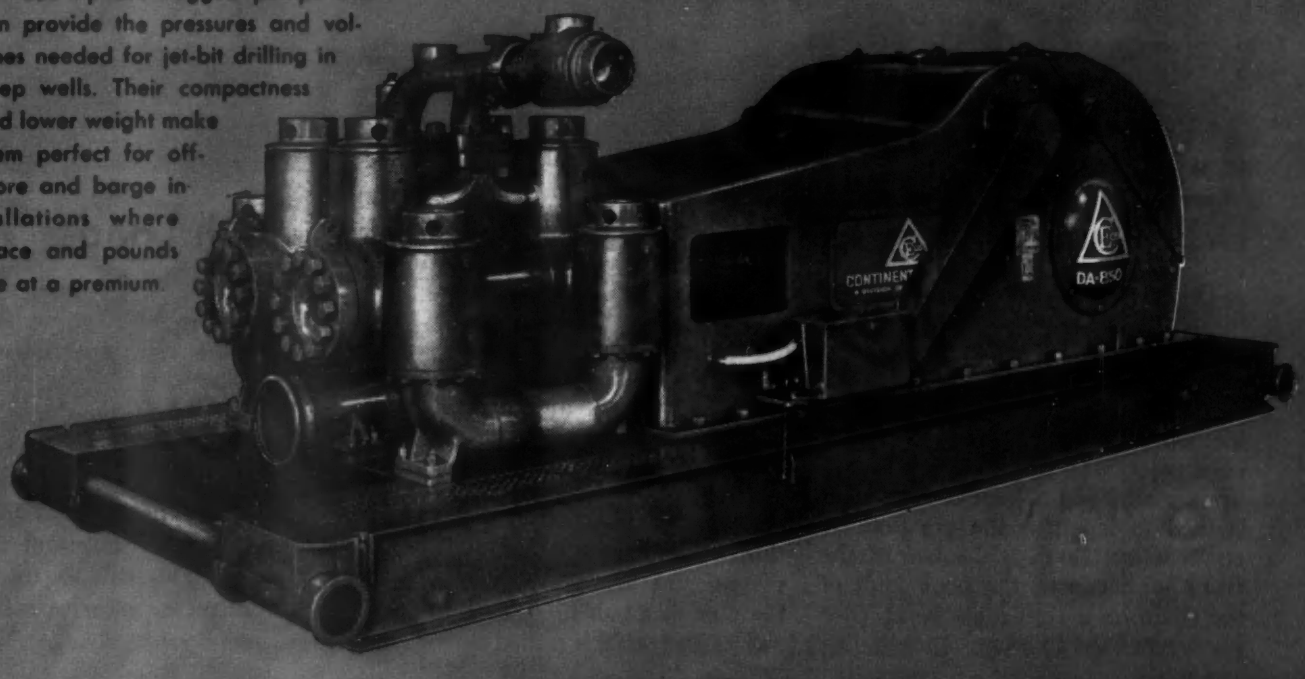
..for Medium-Deep Drilling DA-500 and D-700

These pumps are designed for rigs in the 600 to 1100 horsepower class. Here are pumps *sized* for medium-deep drilling. They are big in capacity . . lower in weight . . yet small enough to require a minimum amount of power.



..for Deep Drilling DA-850 and D-1000

The DA-850 at 850 hp and the D-1000 at 1000 hp are rugged pumps that can provide the pressures and volumes needed for jet-bit drilling in deep wells. Their compactness and lower weight make them perfect for offshore and barge installations where space and pounds are at a premium.



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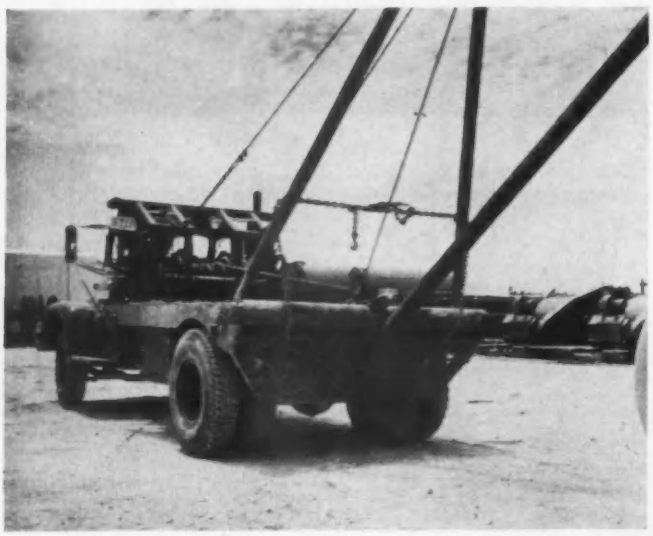
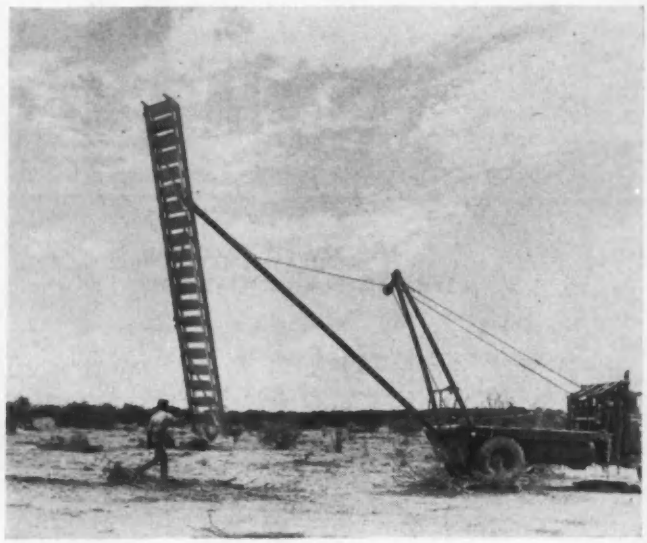




Drill Stem Length and Truck Gin Pole Handle High Loads

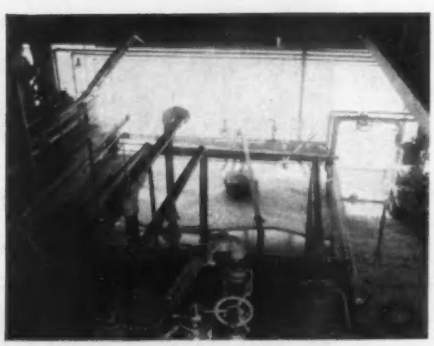
To handle loads requiring higher lifting it is often necessary to lengthen the gin poles of the equipment used in lifting. The photos give the answer as used by one crew to a short cut method of lengthening the gin pole on a truck. The usual gin pole hook-up is made, and a joint of drill stem is used to lengthen the gin pole. A chain is anchored to the bed of the truck with one of the hook ends of the chain on a very short swing (See photo).

The hook on the short swing was placed in box end of the drill pipe. This acts as the anchor for the lower end of the gin pole extension. The cable is run from the reel under the lower block at the bed of the truck, then up and over the upper block. The cable is then run out along the gin pole extension. At about two-thirds the length of the gin pole extension, the cable is passed around the pipe in a half hitch and the hook end of the cable is pulled up tight in the pin end of the pipe extension, shortening or lengthening the cable on the reel, raising or lowering the extension.

In the second photo, the ladder is attached to the extended gin pole by one of the hook ends of a chain. The chain is wrapped around the ladder and fastened by means of the other hook end. This enables the crew to move longer or hard to manage objects more easily.

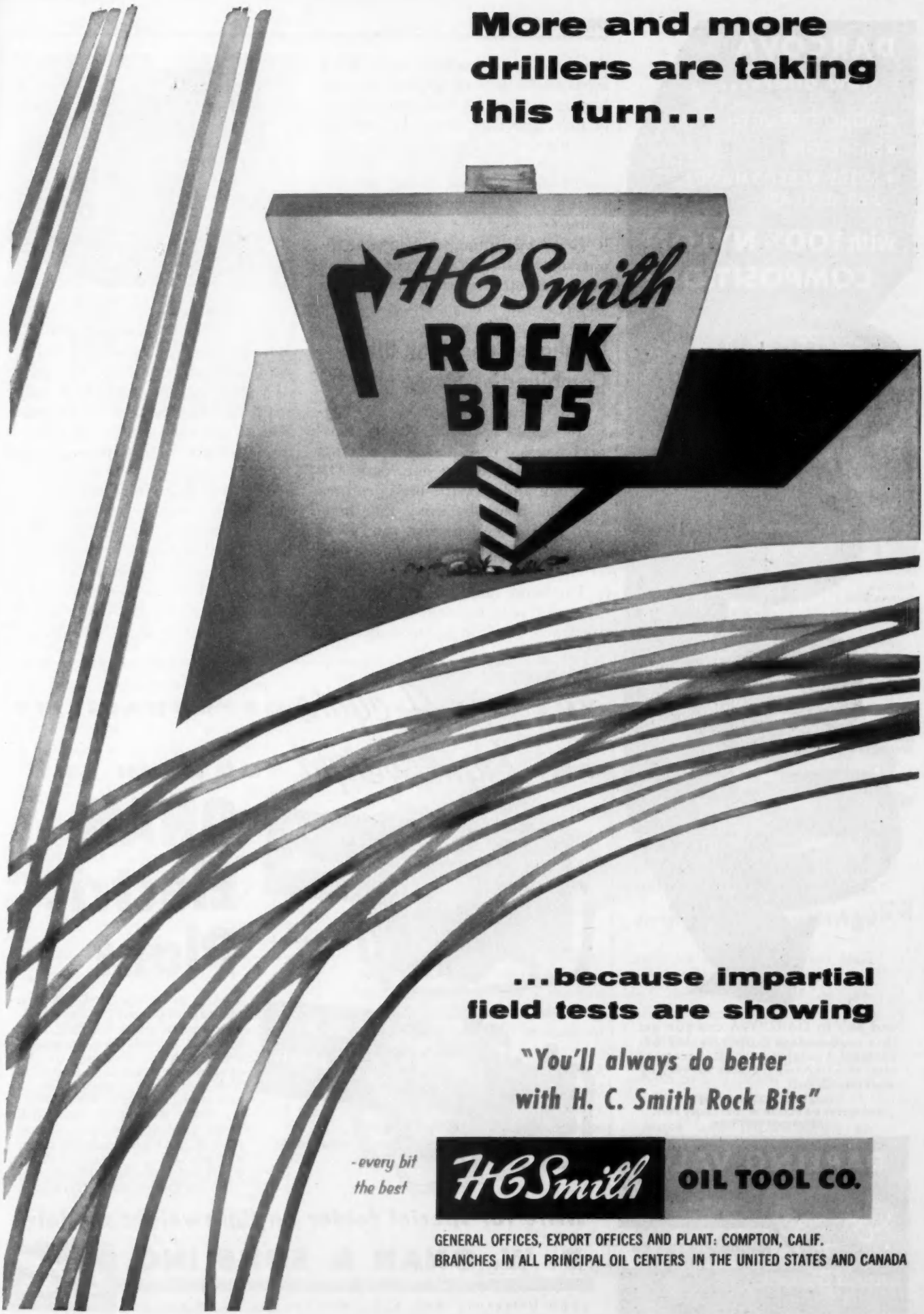
Tank Float Functions As Mud Level Indicator

A float on the mud tank rigged up with a cable and pulleys with a counter balanced weight on the floor, opposite the driller's position, serves as a constant indicator showing level of mud in the tanks. A mark adjacent to the indicator on the floor showing low, normal and high pit levels keeps the driller informed if there is any change in volume.



An occasional glance at the indicator by the driller gives immediate warning of a level change and would speed his chance to close preventers and prevent a blow-out before the well is in danger. A continuous indication of the mud pit level or mud system capacity would indicate if mud is being lost to the formation and if

More and more drillers are taking this turn...



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THE ORIGINAL COMPOSITION CUP

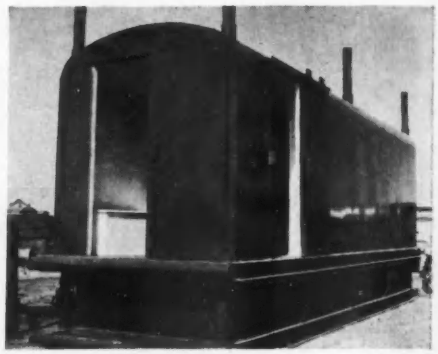
the hole is unloading mud. High levels might indicate the well is swabbing in if crews are making a trip out of hole, also that the well is coming in while drilling through a high pressure zone. A low level could indicate such hazards as hole caving, lost circulation, or a washed hole in the drill string.

This device ultimately will serve the operator and contractor and as well as increasing safety conditions for the crew.

Doghouse and Junk Bin Combined as Single Unit

This modern design of the doghouse enables the contractor to transport the skid base junk bin, supports and doghouse all in one load. The junk bin and supports are integrated with the house by using the three-inch pipe extensions seen protruding through the house as the support legs of the house while on location.

The house built of plate and angle iron and pipe has four-inch pipe in the frame to allow the three-inch pipe



supports to pass through the house when it is in a lowered position, as shown. When the house is lifted for installation, it slides up the three-inch pipe supports until the house is at the desired elevation. The house is held at this elevation by pins driven through holes in the three-inch legs.

This enables the contractor to rig up and tear down in record time and reduces the number of loads necessary for moving the rig, as well as having the doghouse at derrick floor elevation during the drilling of a well. This saves time for the crew in that they are not required to leave the rig floor to enter the doghouse.

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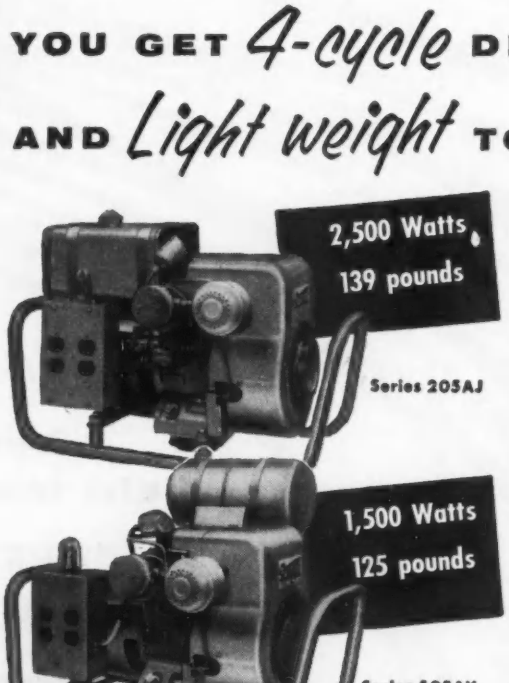

These power-packed electric plants give you all the *4-cycle* advantages of quick starting, long life and trouble-free operation . . . with an amazing weight saving over usual 4-cycle plants. You can carry them easily to any spot . . . and you can count on them delivering their full rated capacity as long as you need it. Both are single-cylinder, air-cooled . . . completely equipped and ready to go.

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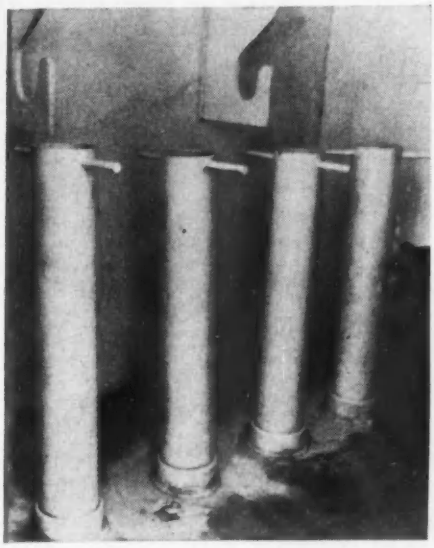

Pipe and Collars Provide Pump Liner, Rod Storage

Expensive pieces of equipment that are easily damaged when carelessly handled or stored around the rig are the pump liners and rods. Most rigs carry at least one spare set of liners and some carry as high as two and three. These liners should have a special storage space; one that will keep them from being knocked and banged around and burring the edges that some day might cause a wash-out of the fluid end of the pump.

One contractor has made a very substantial and convenient racking place in one corner of his pump parts doghouse. By welding one-half of a threaded collar from 4-inch line pipe to the floor of the doghouse, and conveniently spaced as shown in the picture, this operator has provided a base for his liner rack. Approximately 30-inch lengths of 4-inch line pipe were then cut and threaded on one end. On the other end of these lengths of 4-inch pipe, 6-inch pieces of sucker rod are welded so as to form handles, or ears.

When storing liners, the liners are positioned around the half collar that is welded to the floor and the lengths of 4-inch pipe are inserted down through the liners and threaded into the collar so that the liner is held upright and in place. There is very little play between the pipe and the ID of the liner so that any scuffing or marring of the ID of the liner is held to a minimum.

In the upper portion of the photograph can be noticed a slotted plate welded to the doghouse wall. These plates are notched so as to received the rods and plungers that fit the various liner sizes that are in storage. In this manner, liners and plungers are racked conveniently close together and in such a position that damage is minimized.

How-To-Do-It Ideas
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WORLD OIL editors want how-to-do-it ideas, so your favorite short cut or invention could put money in your pocket! Write down the substance of your latest ideas and send them in with a picture or drawing of the installation . . . if accepted, $10 for each idea will be yours. Send those money-making ideas today to Hints Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

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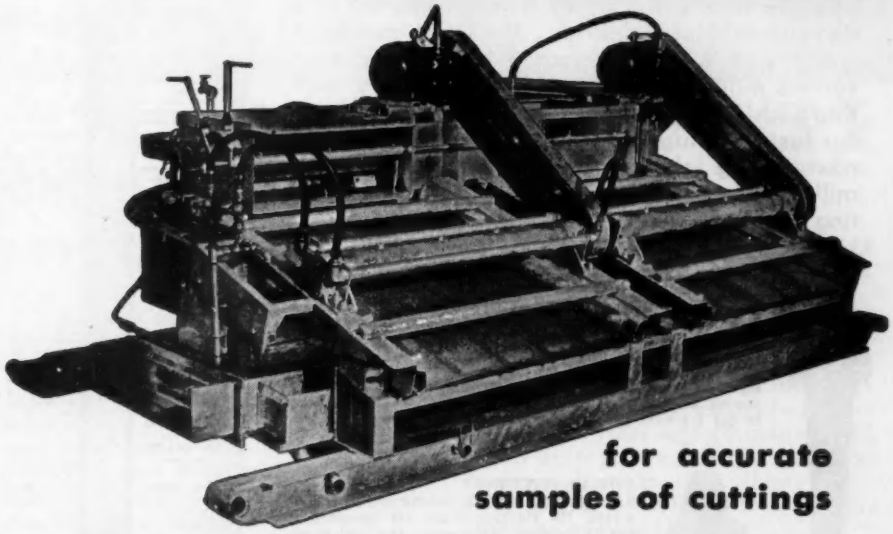

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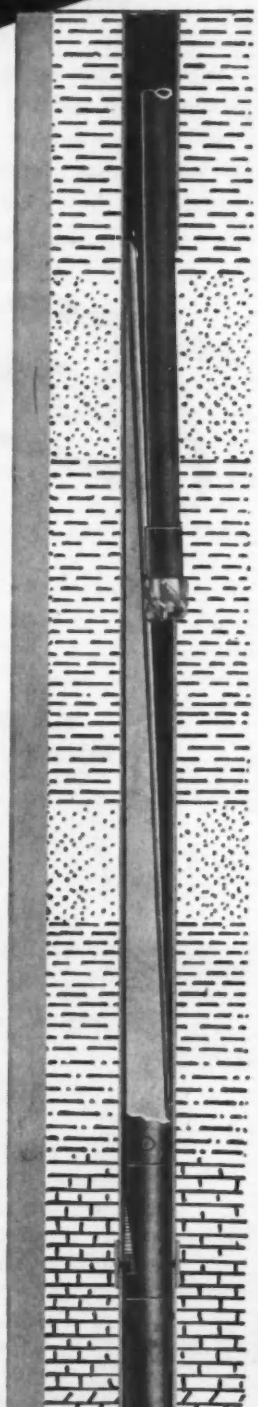


UTILIZING TUNGSTEN CARBIDE PARTICLES that continuously renew their cutting edges, new Kinzbach Speedmills offer you faster, surer milling under even rugged down-hole conditions. Because of their extreme hardness, they require fewer replacements . . . fewer round trips.

Kinzbach Speedmills require less torque for cutting . . . eliminate drill pipe wind-up . . . reduce shock on drilling string. They retain their high strength and hardness at elevated temperatures and are unaffected by heat generated by cutting action. Most important, the close control of speed and weight necessary in ordinary subsurface milling operations is not necessary with Kinzbach Speedmills.

For faster cutting . . . surer cutting, be sure your next milling job is done with Kinzbach Speedmills. Types available for every down-hole cutting problem.

Type 154 Speedmill

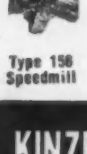
TYPE 154 SPEEDMILL
This mill is designed for attachment directly to a Kinzbach Type H Whipstock as the first tool in progressive milling operations. After the Whipstock is set, the attachment bolt is sheared and milling operations can begin. The lug on the face of the Whipstock engages the tapered pilot of this mill, forcing it to cut through the pipe wall without thinning the top section of the Whipstock. The Model 154 Speedmill is used to cut the first two and one-half feet of window only.

Type 155 Speedmill

TYPE 155 SPEEDMILL
After the first stage of window cutting is completed, the Kinzbach Model 155 Speedmill is run to complete the window. This tool is designed to utilize cutting force reactions so that maximum length of window may be cut, while side blades are designed to resist reduction in gage diameter during operation.

TYPES 156 AND 159 SPEEDMILLS
For general and milling operations. Used to mill up pipe or tools in the well and to shape the ends of obstructing materials for subsequent fishing operation.

Type 159 Speedmill

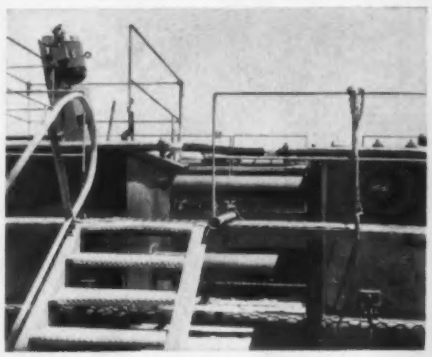


Type 156 Speedmill

KINZBACH TOOL CO INC

Export Office:
74 Trinity Pl.
New York, N. Y.

KINZBACH TOOL CO., INC., P. O. BOX 277, HOUSTON, TEXAS

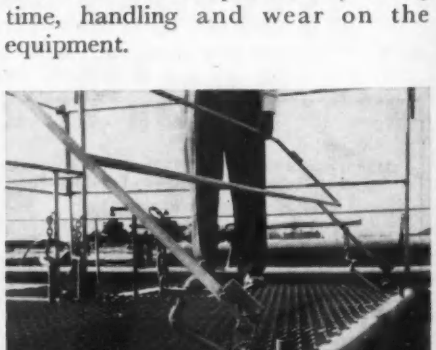


Flexible Hose Reduces Alignment Problems

Alignment problems during rigging of the mud tanks were reduced by one contractor through the use of flexible hose. The photo clearly demonstrates that the mud tank on the right would have had to be elevated to be in alignment.

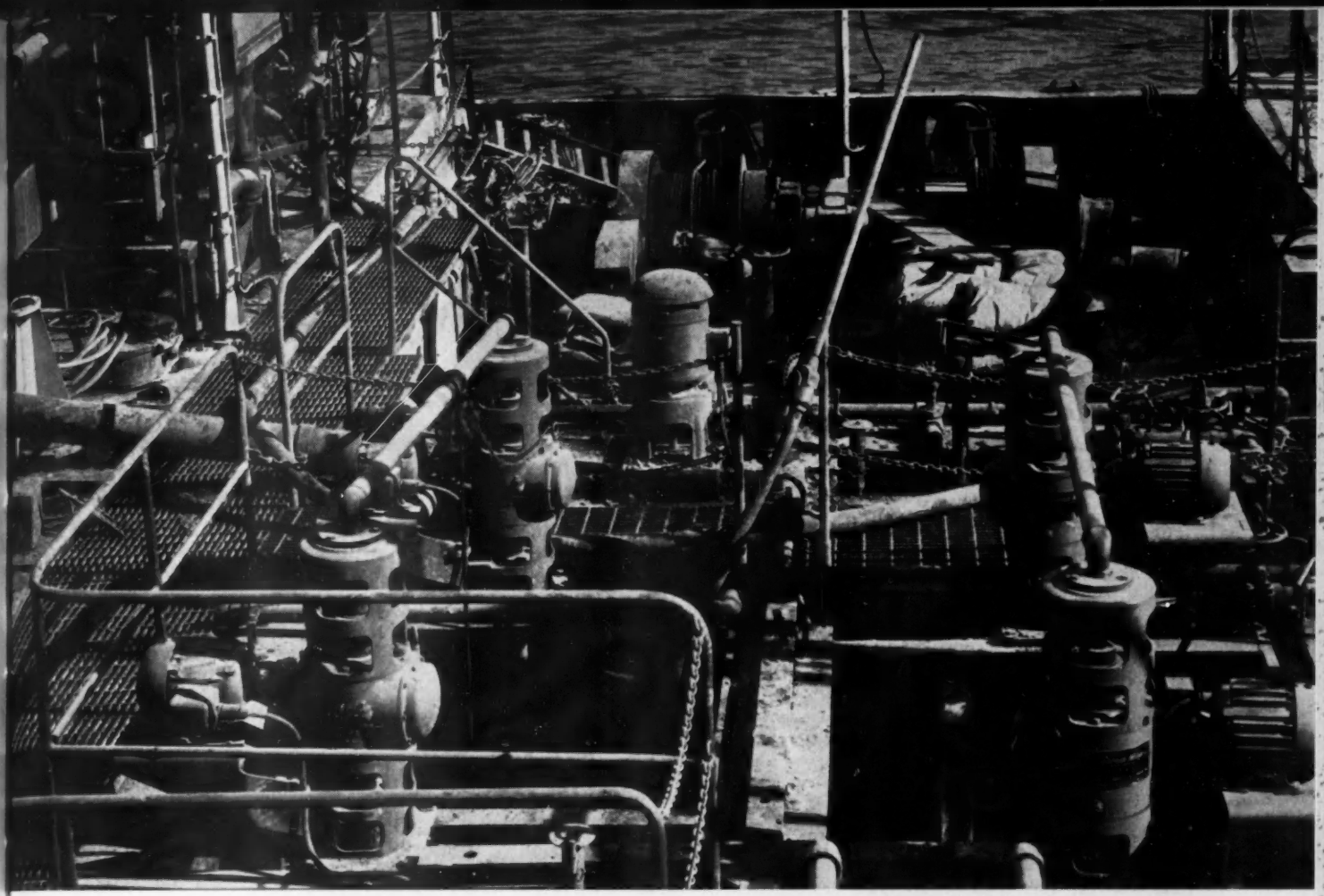
In elevating the tank, considerable time and handling would be necessary increasing rig up and tear down costs. If the tank was not elevated, special fittings would have been required to complete the connection. Special fittings would have increased the time necessary to complete the rigging up as well as being more equipment to take care of during the moving. Either of these methods would have resulted in unnecessary handling of the tank or in consumption of time for hook-up.

By using the flexible hose, both problems were eliminated, as well as reducing the vibrations transmitted from one tank to another. This results in more efficient operation by saving time, handling and wear on the equipment.



Fold-Away Guard Rails Save Time and Space

The simplified installation of guard rail sections used here is the way one



FAST MUD CONTROL IS EASY aboard the Rincon. Four turbine-type LIGHTNIN Mud Mixers, foreground, keep mud uniform. LIGHTNIN Flash Mixer, just left of center, incorporates weight and gel additions as fast as needed and without clogging.

Here's why mud control is no problem *on Richfield's new deep-water rig*

Hop aboard one of the first ocean-going drilling rigs—Richfield Oil Corporation's 600-ton converted LSM Rincon.

A quick glance tells you nothing has been spared to make this pioneer vessel safe, comfortable, efficient as it probes the bottom in waters up to 300 feet deep off the California coast.

Stroll over to the mud tanks and see how the Rincon's drilling crew keeps mud in top condition—ready for instant use.

Uniform mud . . . always

Above the mud tanks you see four electrically powered LIGHTNIN Mud Mixers. From each mixer hangs a shaft with a big turbine at its lower end.

These turbines churn the mud powerfully, creating strong, smooth flow and interchange throughout the tank. In constant motion, mud cannot settle out; *stays fully uniform* at the desired weight and viscosity.

Heavier mud . . . in seconds

When the driller needs heavier mud, he gets it—*in seconds.* Weight and gel additions are fed to the tanks through a LIGHTNIN Flash Mixer mounted in an open-bottom well. A high-speed propeller on this mixer instantly breaks all lumps and disperses weight and gel finely in the mud.

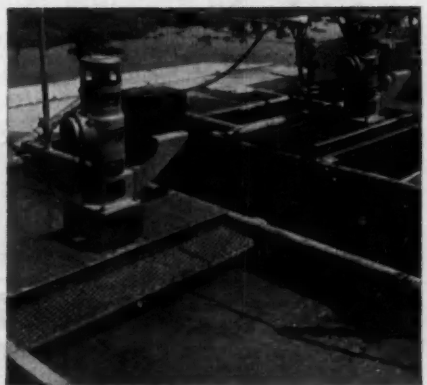
Then the big LIGHTNIN turbines swiftly mix in all additions—equalize the mud *as fast as new ingredients can be fed to it.*

Lower-cost drilling

You get faster, safer, more productive drilling with mixers like these on *your* rigs. Fewer stops; no long waits for heavier mud; *surer protection* against blowouts.

Best of all, you cut drilling cost *with* LIGHTNINS *in your mud tanks. Save the entire cost and upkeep of an extra stand-by mud pump. You need only* one *stand-by pump when you mix with* LIGHTNINS.

See for yourself what amazingly fast mud control you get with LIGHTNINS—at less than your present cost. Your LIGHTNIN Mixer representative will gladly arrange a visit to a LIGHTNIN-equipped rig near you. Call him today (he's listed in Composite Catalog). Or write us direct.



MUD REALLY MOVES. On top, underneath, al through the tank, it keeps equalizing—can't settle out. Powerful flow gives you *instant* control of mud weight and viscosity.

Lightnin® Mixers

MIXCO fluid mixing specialists

MIXING EQUIPMENT Co., Inc., 197-k Mt. Read Blvd., Rochester 11, N.Y.

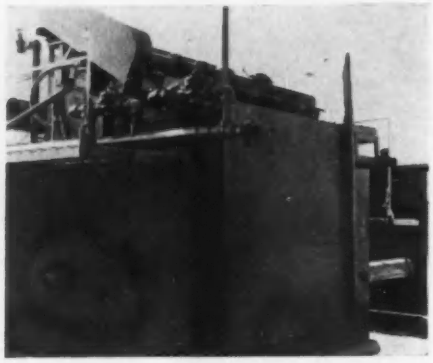
In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Avenue, Toronto 10, Ont.

contractor installs and takes down the sections for moving.

The rail section is made of bar material cut and welded in to shape. On the bottom of each leg of the sections is welded one end of a hinge made from scrap plate. The other end of the hinge is welded to the derrick frame. A short piece of small diameter pipe is welded to the bottom and outside of each leg and a like piece of pipe is welded to the rig frame so that the pipe on the leg is lined up and just clears the top of the pipe welded to the frame.

When the rail section is in the upright position, a pin small enough to fit into the pipes and long enough to extend through both pieces of pipe is welded to one end of a short piece of chain, and the other end of the chain is welded to the guard rail leg. In this manner, the pin can drop through the pipes when the sections are set up. While the rig is being transferred, the chain would keep the pin from being lost.

Similar pin joints are welded to the guard rail sections at the top to steady the section and tie them together.



Shale Shaker Apron Can Be Quickly Folded for Moving

The shale shaker apron is quite often lost or bent. It can be neatly and quickly mounted with little trouble and be kept handy at all times. This photo demonstrates a well designed approach to simplify the installation and reduce time and work in erecting and stowing this device. The materials needed for construction are metal plate, angle iron and bolts.

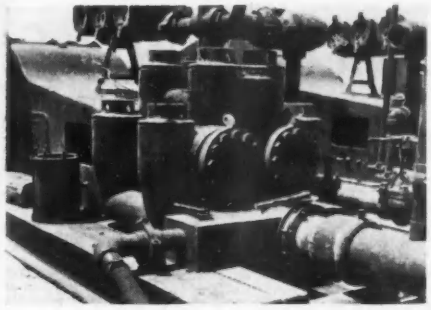
A plate is cut and welded to the size desired for the apron, the angle iron is welded along each side of the apron, forming the sides of the apron as well as bracing and stiffening the apron. Four to eight holes are cut in each upright side of the angle iron. Each set of holes is exactly aligned, and the angle iron legs are attached to the apron by means of bolts. These bolts act as hinges on the legs. Small brace pockets are welded near the bottom of the shale shaker. These pockets give the legs positive footing, maintaining the apron on one plane. The apron is mounted on the shale shaker on hinges to facilitate raising and lowering.

To rig up, the legs are swung out around and down. Then the apron is raised by two men. As the apron is raised, the legs clear the ground and are swung back to the pockets welded at the bottom of the mud tank. This gives the apron its angle. The angle of the apron can be adjusted by moving the brace legs back and forth along the apron in the holes drilled in the sides. This slows or speeds flow as desired.

To stow for transport, the legs are lifted from their pockets and swung up, out and around and bolted to the side of the apron, as shown in photo. The apron is lowered until it is

WHAT'S HE PUTTIN' IN THE HOPPER?
SEECO-MUL EMULSIFIER— MAKES BETTER HOLE CONDITIONS ... DRILLS FASTER ... GIVES MORE TIME ON BOTTOM
"SEECO-MUL MAKES A GOOD MUD BETTER"
SEECO-MUL

against the front of the mud pit and is ready for transport. This consolidates the rig, protects the apron and saves rig up and teardown time.



Freeze Box for Mud Valves Is Cold Weather Safeguard

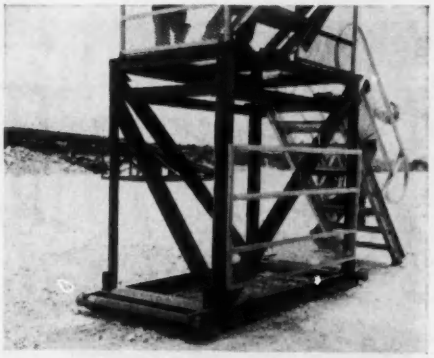
A cold weather danger that may be easily eliminated by the use of the freeze box, as shown in the picture may save money and time for the contractor. The freeze box is constructed around the valves on the water line of the mud pumps suction.

The only material necessary for construction is metal plate, and the pieces are easily welded around the valves after they have been cut to shape. The plate is first cut to length so that it can cover the entire valve but short enough to clear the union connection in the line. The end plate of the box is cut out for the pipe coming into the water line valve and is cut to fit snugly around the pipe.

A hole is cut in the cover of the box to allow the valve stem to protrude for operation. The box is constructed so that the intake line of the mud pump acts as one end of the box. This not only protects the valve but in cold weather, the box is packed with insulating materials to keep it from freezing. This saves time and money for the contractor by keeping the valve operating.

Skidbase Platform Makes Safe Landing for High Rigs

On many tall rigs it is necessary for a landing on the ladder between the ground and derrick floor. One contractor who used a skid-mounted platform for this landing also used the platform for storing the rail sections in transit. The platform built of angle iron on a skid base had short pieces of pipe welded to the frame at the bottom and top. The bottom pipes were used to hold the rail sections for transit and the top pipes



were used to hold the section around the landing during drilling. This same method for erecting rail sections could be used around the rig floor.

Three of the sections on the landing were the same size, and one section was longer. The long section is shown mounted on lower part of the platform for moving. The short sections have been installed at the top of the platform. This method of mounting rail sections makes handling easy. One or two men can erect or take down the sections in a matter of seconds. These sections are also protected from being lost or thrown away, or unnecessarily bent during moving. The compactness of the unit reduces the space required for moving.

drill a gauge-sized hole... control heaving and sloughing with Seeco-Mul

One of the reasons for the current trend toward emulsion muds is the better hole conditions the systems afford. In almost all areas, emulsion muds increase drilling rates, make better hole conditions, drill into pay formations better, afford better coring, and protect the pay zone from water more effectively. Such factors are easily projected into substantial cost and time savings.

A Seeco-Mul mud has an exceptionally low filtration rate because the oil in the emulsion is effectively dispersed and the pores of the filter cake are plugged by a tough film. Holes can be drilled more nearly to gauge, with fewer and smaller washed-out areas. A hole drilled to gauge size also requires less mud, and less cement for the oil string. Seeco-Mul builds up a tough, thin wall cake which reduces fluid loss and sloughing and heaving in shale formations. And once a Seeco-Mul emulsion mud system is established, no special maintenance is required; only routine testing and treating is necessary.

In some fields, Seeco-Mul has reduced mud costs and rig time by as much as one-half over ordinary muds. Using Seeco-Mul might do as much for your drilling programs, too. Ask your mud dealer, or write to us. We'll be glad to send you illustrated literature and a lab sample without obligation. Crossett Chemical Company Division of The Crossett Company, P. O. Box 271, Crossett, Arkansas.

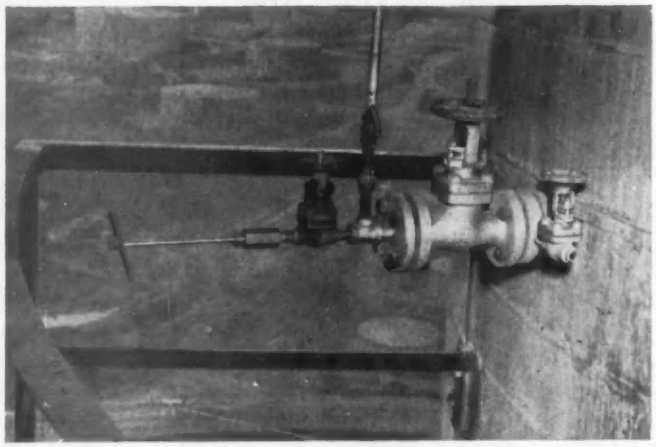
Seeco-Mul *emulsion muds drill faster, better, save drilling costs*

PRODUCTION HINTS

These How-To-Do-It Ideas Can Save You Money

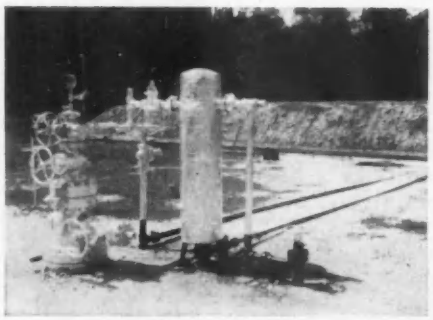
$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

Clean Pressure Tap Manifold With Ease



Pressure taps often become plugged due to the accumulation of fine sand or other foreign material in pressure gage lines. This arrangement allows a complete cleaning without dismantling the entire manifold or trying to use compressed air.

To do this without disturbing the operation, the following procedure may be used. Close the block gate, remove the purge air connection and install a shopmade drill with a packing gland as shown in the photograph. When the block valve is opened, the line can be rodded out with a spade-tipped drill. In this way, the pressure tap manifold can be cleaned and be back in service in a very short time.



Keep Sand From Separator With a Shopmade Trap

Wells making sand under moderate and high pressure can cause operators unnecessary maintenance cost because of abrasive destruction to valves and other wellhead connections. Unless a sand trap is installed between the wellhead connection and the separation facilities, necessary replacement costs usually become very high. One operator has prevented sand from reaching the separation facilities by installation of a simple shopmade sand trap on the discharge side of the flow line, as illustrated in the picture.

The well pictured in the illustration is a relatively low pressure gas producer making a considerable amount of sand. A piece of 10¾-inch pipe was used for the trap container. Each end was welded and installed upright on a base with four supports. A one-inch connection was welded in the bottom to bleed off sand or other materials settling in the bottom of the tank. The one-inch bleeder line empties the trap when the valve is opened blowing sand and other materials into the pit. The tank, approximately 5 feet high, has a two-inch inlet line from the well and a two-inch outlet to the separator.

On a gas well installation of this type, it was necessary to wrap the tank with asbestos insulation to keep the trap from freezing up during low temperature periods.

The trap serves as an inexpensive, effective method to separate out sand and any other material in the well stream allowing water, gas and distillate to carry over into the two-inch outlet line to the separator.

Selectivity of Tank Inlet Gives Ease of Operation

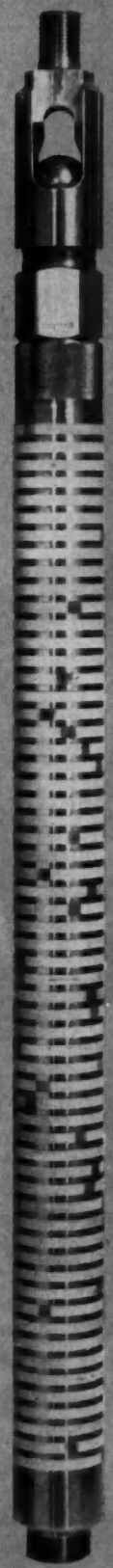
In fields where wells produce a high paraffin content crude, it is often desirable to place the inlet opening of the tank opposite the thief hatch to obtain accuracy in gaging and sampling tank bottoms for water content. A tour of most fields will show the observer that most inlets are placed near the thief where the valve controlling the inlet to each tank is

How-To-Do-It Ideas Earn Money, too!

WORLD OIL editors want how-to-do-it ideas, so your favorite short cut or invention could put money in your pocket! Write down the substance of your latest ideas and send them in with a picture or drawing of the installation . . . if accepted, $10 for each idea will be yours. Send those money-making ideas today to Hints Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

Metal to Metal Wear...

is the real villain in sucker rod pump troubles. It accounts for most of your repair and pump pulling expense.



The Martin Idea...

for getting away from this trouble has always been to make use of the best available materials — *Natural Rubber* for the key material in plunger rings; *Synthetic Rubber* for the key material in resilient ball guides for cages.

The accurately grooved and drilled metal body of **The Martin Plunger** does not touch the barrel. Only the resilient rubber and duck rings contact the barrel. This material — with its great natural resistance to abrasion as well as its slipperyness-when-wet — has a much slower wearing action on the barrel. Most often your barrel will not need replacing. These rings have an amazing ability to take the kind of abuse that goes with oil well pumping, and this means longer runs. Plunger cost is reduced because replacing the rings costs only about one fourth as much as a new plunger, and this saving is, of course, added to the barrel saving and longer runs.

Patent No. 2,591,174

The Martin Rubber Guide Cage protects the ball from all metal contact except when it rests upon its seat. The ball is protected to such an extent that ball and seat life is usually doubled. The synthetic ball guide and stop cannot beat out because of its resilience. Its life is therefore much greater than any metal and you get this longer cage life in addition to better ball and seat life. The two guides are easily replaced when the occasion does arise.

No real capital outlay is required to get these benefits because the cost of Martin Plungers and Martin Cages is very much the same as you are now spending for replacements — sometimes less.

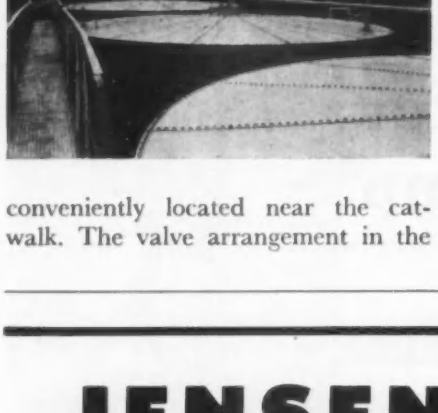
All regular or stroke-thru ROD PUMPS and TUBING PUMPS can be equipped with Martin Plungers. Martin Rubber Guide Cages are made in all sizes and styles. Write for our catalog No. 4; also see Composite catalog for 1956-57.

JOHN N. MARTIN

Manufacturer

9 W. BRADY • TULSA, OKLA.

PRODUCTION HINTS . . .



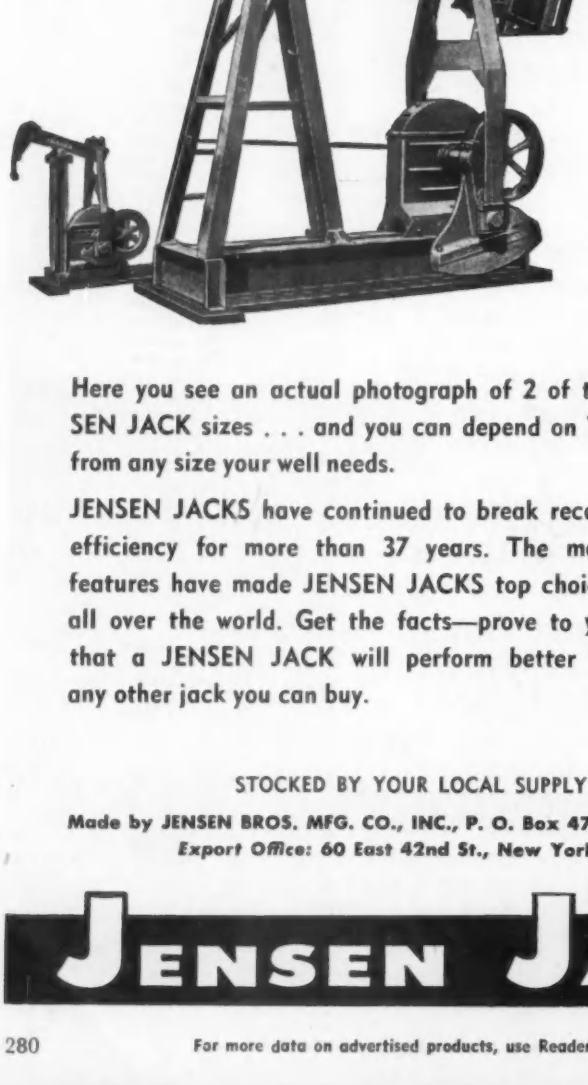
conveniently located near the catwalk. The valve arrangement in the picture serves to increase accuracy in gaging and sampling where the paraffin crude accumulation generally presents a problem.

In order to eliminate inaccuracy and still give the gager ease of operation in shutting off the crude supply to each tank, one operator has employed the method of using a hand wheel with a rod to close the tank inlet from the stairway. Two arms in a V-shape made of a ⅞-inch rod are welded to the ⅞-inch rod across the tank top and then are welded to the hand wheel on the inlet valve. Two supports are made of ½-inch steel plate approximately two inches wide and 12 to 14 inches long to support the ⅞-inch rod. The base of the support is bolted to the top of the tank, and a hole is cut for the rod support with proper clearance to allow rotation of the rod.

Although there are many variations for arrangement of inlet production lines to battery installations, this method is a very effective means to solve the paraffin accumulation problem near the thief hatch.

JENSEN JACKS

TOP PERFORMERS . . . all 14 of 'em!



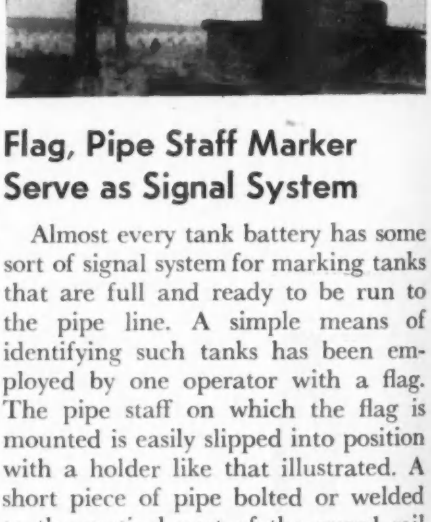
Here you see an actual photograph of 2 of the 14 different JENSEN JACK sizes . . . and you can depend on TOP PERFORMANCE from any size your well needs.

JENSEN JACKS have continued to break records for economy and efficiency for more than 37 years. The many one-man service features have made JENSEN JACKS top choice of production men all over the world. Get the facts—prove to your own satisfaction that a JENSEN JACK will perform better over your well than any other jack you can buy.

STOCKED BY YOUR LOCAL SUPPLY STORE

Made by JENSEN BROS. MFG. CO., INC., P. O. Box 477-D, Coffeyville, Kansas
***Export Office:* 60 East 42nd St., New York City, U.S.A.**

JENSEN JACKS

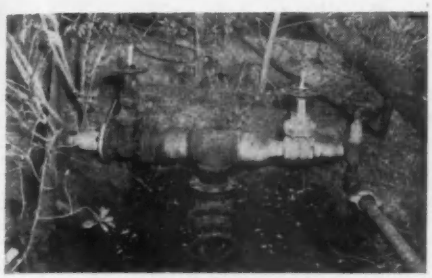


Flag, Pipe Staff Marker Serve as Signal System

Almost every tank battery has some sort of signal system for marking tanks that are full and ready to be run to the pipe line. A simple means of identifying such tanks has been employed by one operator with a flag. The pipe staff on which the flag is mounted is easily slipped into position with a holder like that illustrated. A short piece of pipe bolted or welded to the vertical part of the guard rail frame serves as the holder.

The holder can be made from a one-inch diameter piece of scrap pipe cut to a length of approximately eight inches. A piece of metal three inches in length is welded to the holder and then bolted or welded to the vertical member of the rail. The position of the holder should be such that the flag staff base rests on top of the tank edge.

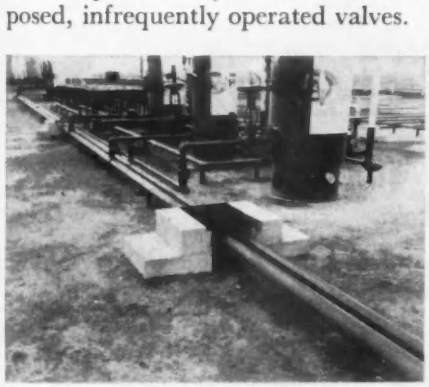
This type signal system shows which tank is full and ready to be run, thus saving the switcher many steps in the personal inspection of each tank. The switcher can drive through the field, look for flags and know without stopping which tanks are ready to be run.



Foil Protects Threads Of Rising Stem Valve

In coastal areas frequently blanketed by fog or subjected to the corrosive action of salt air, rusting or fouling of the exposed threads of a rising stem gate valve may cause premature removal or overhauling of the valve. Much of this source of trouble can be eliminated by equipping the field men with a small roll of aluminum foil with which to cover the exposed stems.

Wrapping the stem tightly with one to two laps, then squeezing it to the stem tightly with the hand, will cause the foil to adhere closely to the threads and remain so until the valve has to be operated again. The practice is particularly valuable on exposed, infrequently operated valves.

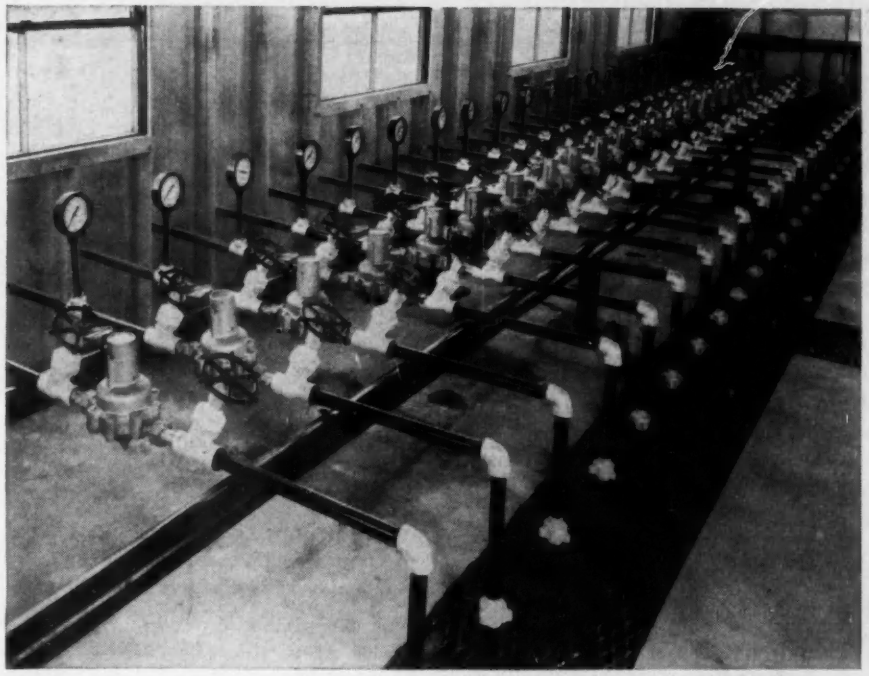


Build Steps Over Piping For Reduced Maintenance

Most operators that have experienced corrosion maintenance on lines buried below ground level around separator-battery installations have realized the need for lines and piping above ground. Placing lines on supports as shown in the picture is getting to be the most popular method of installation.

One operator using this method of installation to reduce corrosion maintenance costs had concrete steps with a neat steel grill foot mat mounted as illustrated. This practice has proved both economical and effective.

The steps placed at convenient lo-



Edward steel valves guard and guide the flow in this big Texas water flood project.

"No maintenance in more than a year

for these Edward Globe Valves in water flood service!"

By JACK STIVERS,
Drilling and Production Supt., Miami Operating Co., Inc., Abilene, Texas

"Over a year ago," says Jack Stivers, "we installed forty-two of these Edward forged globe valves on the KMA Unit, Kempner Field, Wichita County, Texas, Flood. They've throttled since the day we started the flood—and we've had absolutely *no* maintenance costs so far. 2,063,905 barrels of water have been metered through these valves. Yet they *still* shut off tight—without forcing—to isolate meters. Bud Oweiss, our Edward representative, recommended this type of valve, and we are glad we followed his advice. In fact, we're using the same type on our newest flood, too, at Acme Unit, Clay County, Texas."

The Edward valve recommended for this service was Fig. 2698 forged steel, inside screw globe valve. This valve has a precision-built interior, with no pockets to collect sediment; EValized bonnet and packing nut to prevent thread galling . . . and centerless ground stem for long packing life—and packing is easily adjusted or replaced, if ever necessary. If you've been on the lookout for an efficient, dependable valve for water flood service—and want it at moderate cost—you'd be wise to contact your nearest Edward oilfield representative . . . or your favorite oilfield supply store.

Edward Valves, Inc.
Subsidiary of
ROCKWELL MANUFACTURING COMPANY
1214 WEST 145TH STREET
EAST CHICAGO, INDIANA

Fig. 2698
2000 lb WOG
Globe Stop
Valve

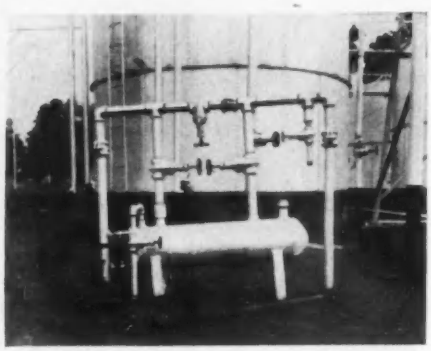
For more data on advertised products, use Readers' Service Cards, last page.

cations around the installation eliminates the posibility of injury from tripping and falling over the pipe and serves as a protector. Constant stress set up by people walking across piping will eventually weaken connections and ultimately cause leaks and unnecessary trouble.

Not only do the steps over the piping installation reduce the possibility of injury to personnel working around the storage and separation facilities, but it also presents a neat, well-kept appearance. A neat appearing installation improves working conditions and ease of operation.

Build Gas Odorizer Tank From Casing and Angle Iron

Where gas from the low pressure separator of a lease is used for fuel to supply company houses, offices, warehouses or shops, it is desirable to odorize the gas for safety practices in case of a leak. One company has built an effective but economical odorizer from a piece of 10¾ inch casing supported by angle iron and connected to the gas supply inside the firewall of a nearby tank battery.



Each end of the casing section is welded to form a pressurized volume tank by means of cutting and welding small segments in each end section of the casing. The angle iron supports are welded to the base of the tank and openings cut for the gas supply, outlet, vent line and odorizer supply. Connections are then welded into the top of the tank, on one end two openings are cut and connections welded for installation of the liquid level indicator.

Note the by-pass connections and bleed-off valve facilitating venting of gas in the tank and in the odorized fuel supply line.

Color Battery Flow Lines To Faciliate Identification

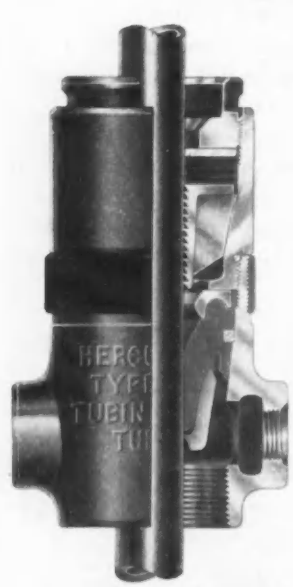
In order to save time and avoid confusion among the uninitiated and the new visitor or worker around a lease, some operators have resorted to color identification of the various lines, valves and connections around a tank battery. In order to properly identify the various fluids carried in these lines a chart such as follows is recommended:

COLOR	FLUID CARRIED
Red	produced fluid
Light Blue	control air or gas
Dark Blue	Produced gas
Yellow	test line
Light Green	treated oil
Black	water

Lines from producing wells entering into the battery enclosure above ground are painted red to the production manifold. The production line from the manifold to the separator is also painted red. Lines coming from the production treater are painted according to the chart. The

You get the most ECONOMICAL SERVICE from...

HERCULES TUBING HEADS

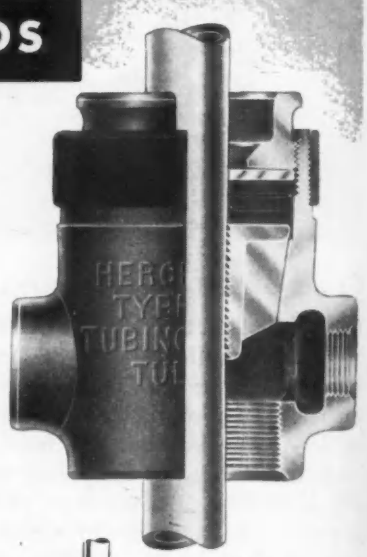


"TYPE J-5" TUBING HEAD

Ideal for flowing or pumping wells or for well servicing and repressuring projects. Will suspend 2" tubing to 5½" casing up to maximum of 180,000 pounds. Head is full-opening; constructed of pressure cast steel tested to over 4,000 psi. HERCULES original overhead packing arrangement and hinged slips facilitate installation and servicing. HERCULES Neoprene Tubing Stripper (2" - 2½" - 3") may be used in this head on wells flowing intermittently or to wipe tubing. Equipped with safety threads.

"TYPE J-5-S" STRIPPER TUBING HEAD

The dual purpose "Type J-5-S" Stripper Tubing Head is basically a "Type J-5" Tubing Head with a bowl (top section) screwed into the packing nut thread. The hinged slips, packing and packing nut are installed in the bowl (top section) with the tubing stripper in the body (lower section), thus permitting tubing to be run-in or removed under pressure. Test pressure is the same as the "Type J-5" Tubing Head.



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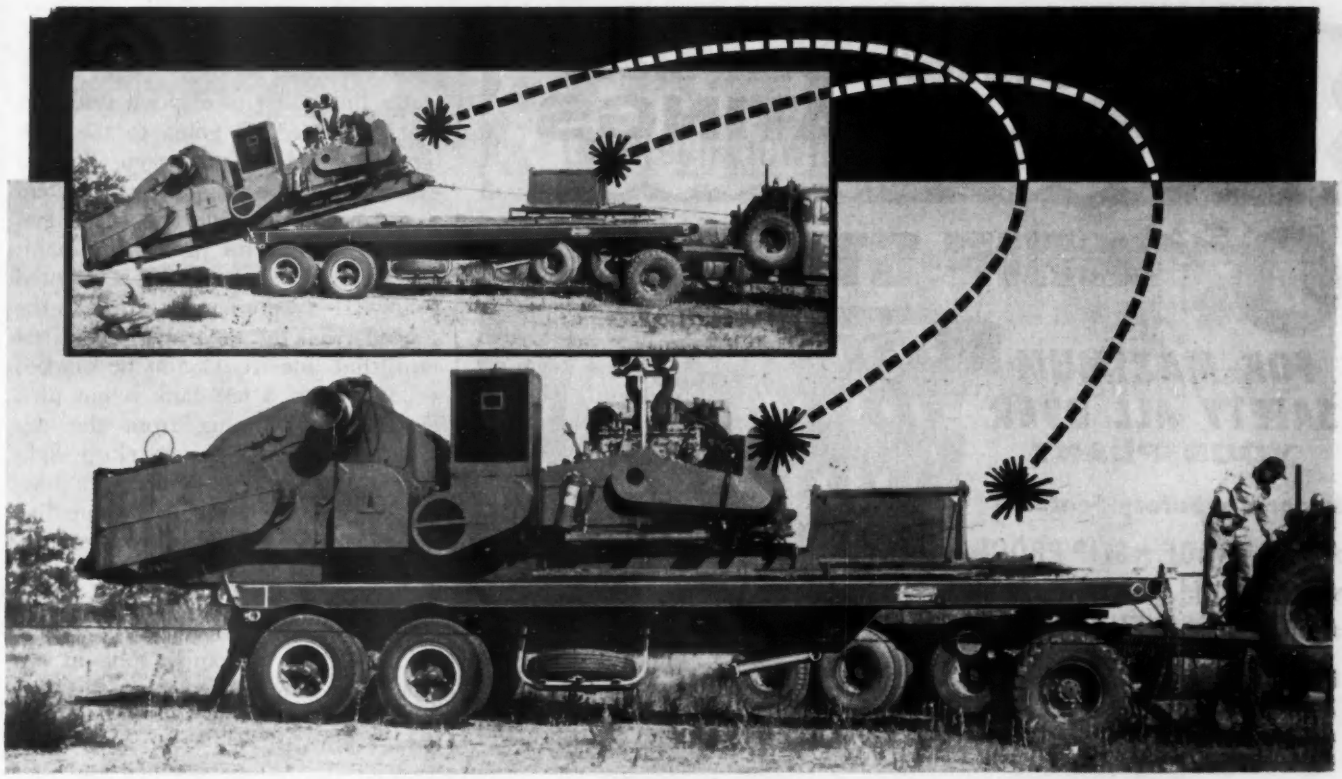

Even 75,000 Pounds Doesn't Bow the Back of This 9,600 Pound LOADCRAFT 808...

LOADCRAFT'S 808 answers the industry's demand for a lightweight trailer... made to carry that extra heavy payload. This new heavy-duty oil field trailer actually weighs less than conventional trailers... yet can carry 5 TONS more payload. This new trailer is made entirely of special formula 808 steel... the greatest weight to strength ratio ever developed in oil field trailers. The main frame is full 18 inches deep and the outer rail is 9 inches. It is designed so when nose loading with the ***LOADCRAFT*** 808, the deep frame rests firmly on the ground to give three point stability... it has 7½" rolling tail pipe with self-aligning bushings for rear loading... heavy-duty rear bumper and the new rocker beam tandem. The ***LOADCRAFT*** 808 gives more payload per trip... requires less trips per job... pulls easier – uses less gasoline... and you pay no more for ***LOADCRAFT*** 808 than for an ordinary trailer. The ***LOADCRAFT*** 808 is the finest oil field float ever produced!

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BY GLOBE

1 Safety GRIP-STRUT®

FOR MAXIMUM SAFETY ALL OVER YOUR PLANT

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★ MINIMUM WEIGHT

Important Economy Features

★ All one piece, not welded, riveted or expanded
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★ Cut and installed like lumber by your own maintenance force. ★ Low in original cost. ★ For balconies, no secondary sprinkler heads needed

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★ 3/16" projection weld nugget for greater rigidity and strength
★ Vertical alignment of the main load bar assured
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PROJECTION WELD

Each secondary load bar (A), as projected welded to the primary load bar (B) has a shear strength of 5,000 pounds per weld. There are 28 such projection welds to a square foot of grating. This means that GOLD NUGGET Welded Grating can sustain greater shock loads than other gratings.

10,000 POUNDS

For the complete details of these revolutionary new gratings, write for new catalogs today. Distributors in all principal cities. Consult the yellow pages in your phone book under "GRATING".

108

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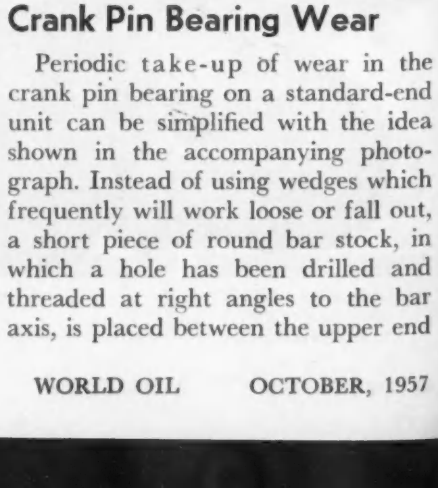
The GLOBE Company MANUFACTURERS SINCE 1914
4008 SOUTH PRINCETON AVENUE • CHICAGO 9, ILLINOIS

PRODUCTION HINTS . . .

water line going to disposal system is black. Treated oil going to the tank battery would be light green. Treated gas going to the gas gathering system would be a dark blue line. Test lines and valves from the production manifold to test separator would be painted yellow. If it were necessary to run the test oil from the separator into a test tank that line would also be marked yellow and if a test tank is not used the oil line coming from the test separator would be marked light green. If pneumatic valves are used for control, then the light blue line is used for this control air or gas. All valves and inlet fixtures on these lines are painted in the same code.

If a color chart of this type could be posted in a handy spot in the pumper's shack, then well servicing companies, new relief pumpers or other individuals who must work around the battery for the first time would not have to guess at any individual tank hook-up. Considerable time would be saved as well as possible costly errors in working around the battery.



Threaded Device Takes Up Crank Pin Bearing Wear

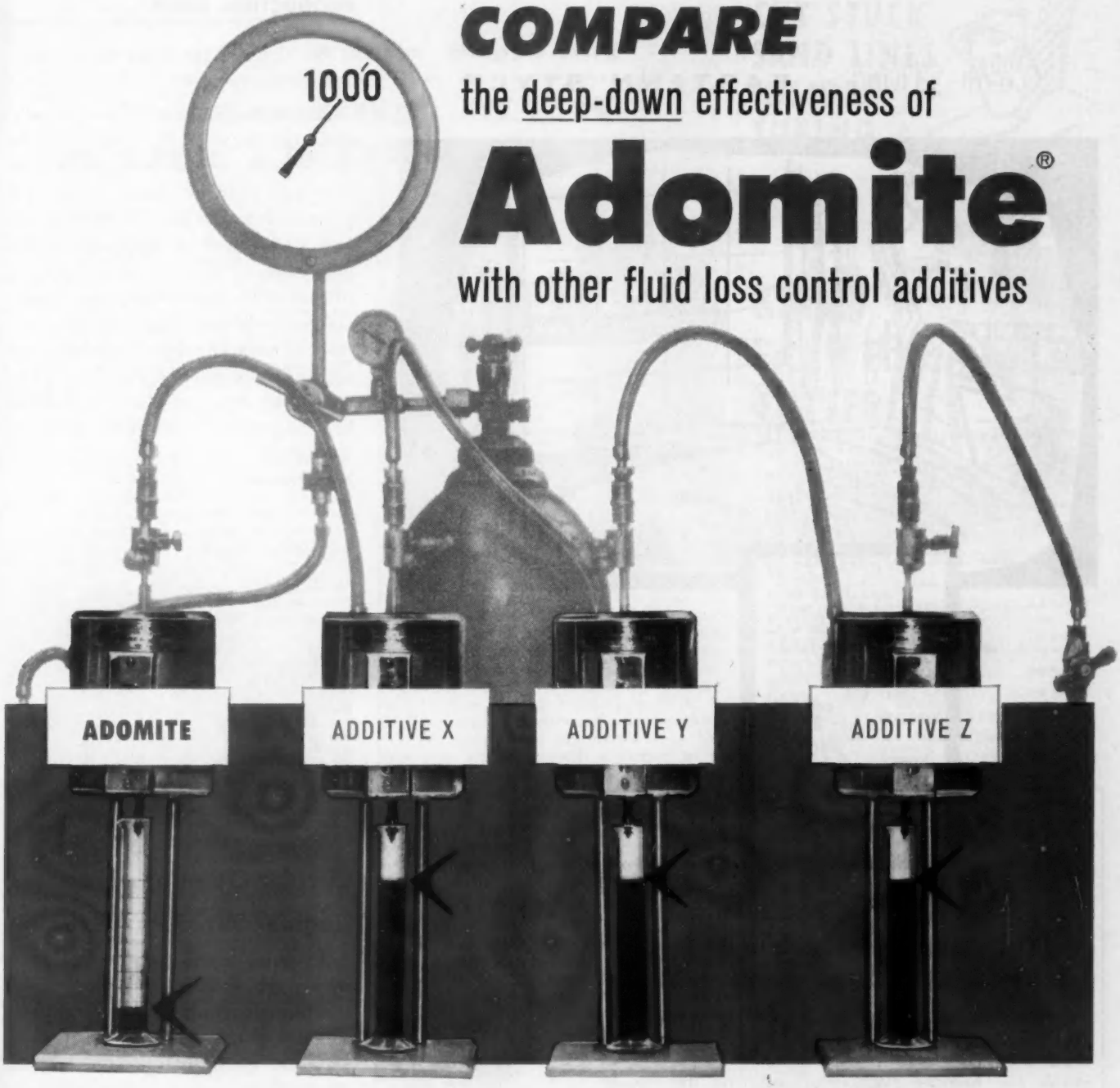
Periodic take-up of wear in the crank pin bearing on a standard-end unit can be simplified with the idea shown in the accompanying photograph. Instead of using wedges which frequently will work loose or fall out, a short piece of round bar stock, in which a hole has been drilled and threaded at right angles to the bar axis, is placed between the upper end

COMPARE

the deep-down effectiveness of

Adomite®

with other fluid loss control additives



Just how effective is your present fluid loss control additive at bottom hole conditions? As you undoubtedly know, many fracturing additives show desired fluid loss control at surface conditions of low pressure and room temperature. But at bottom hole conditions, fluid loss becomes so high that their effectiveness is lost. Compare them with Adomite. Tests show that, *deep down*, nothing safeguards your profits like Adomite.

What makes the difference?

Adomite, when mixed with oil, disintegrates into millions of tiny particles. These particles seal the face of the formation and keep the fracturing fluid from filtering in. Temporarily sealing the formation, Adomite particles do not plug it.

Other additives, too, contain sealing particles, but these tend to soften or dissolve as temperatures increase. Result: fluid loss control is greatly reduced.

	Fluid Loss at Surface Conditions— 100 psi,* 75°F., cc/30 min.	Fluid Loss at Bottom Hole Conditions— 1000 psi, 150°F., cc/30 min.
ADOMITE + crude oil	**2.2**	**22.0**
Additive X + crude oil	**37.8**	**Infinite**
Additive Y + crude oil	**8.5**	**Infinite**
Additive Z + crude oil	**13.0**	**295 (1 min., 50 sec.)**

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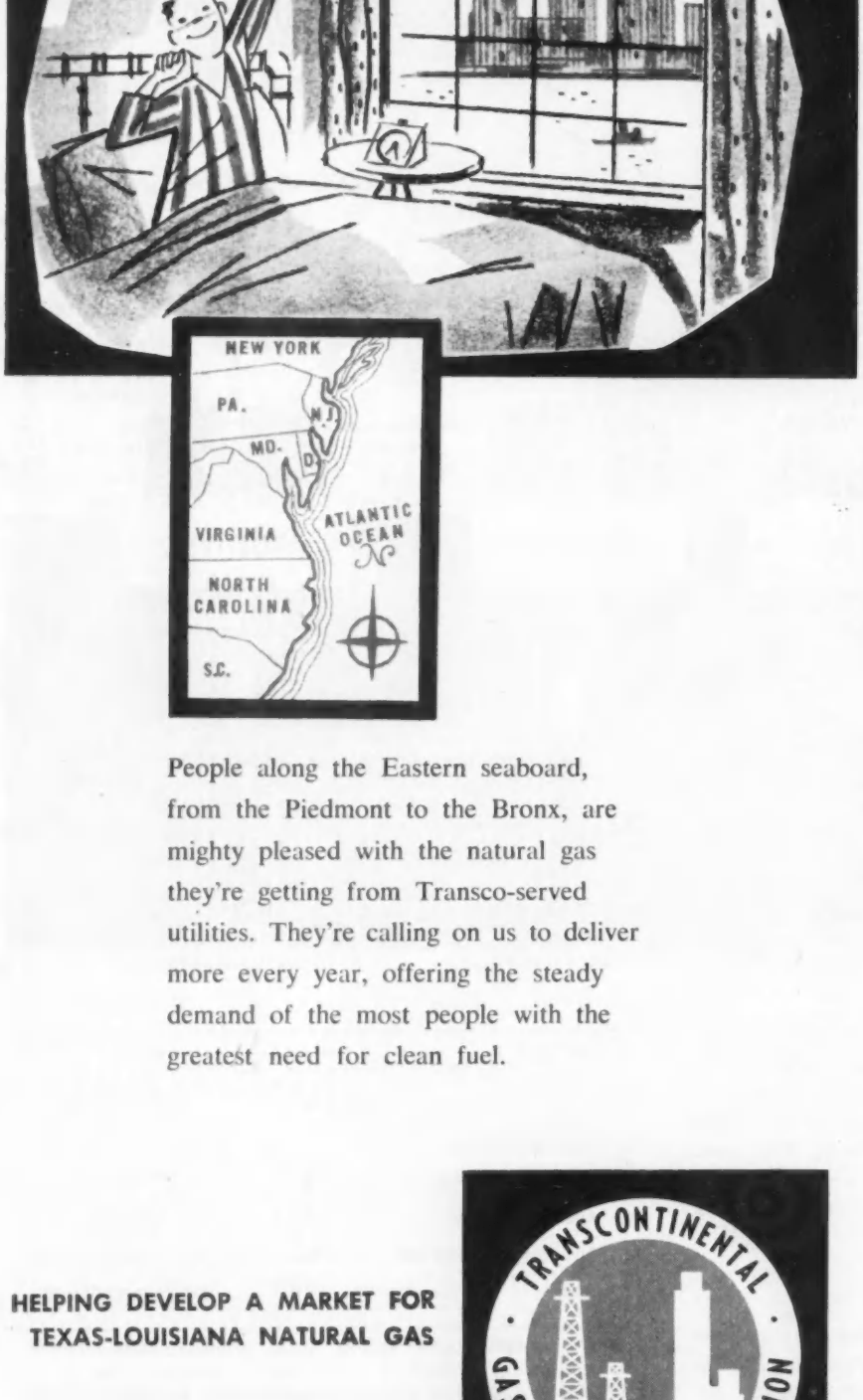
(*Standard API Code 29 Test)

To get best results downhole with straight crude, gelled crude or refined oil, always *specify* Adomite.

FRACTURE WITH ADOMITE

Clean Living . . . EASTERN STYLE



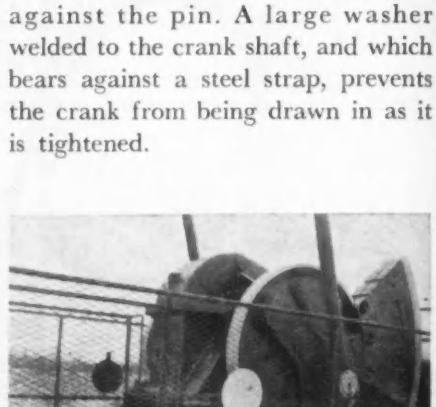
People along the Eastern seaboard, from the Piedmont to the Bronx, are mighty pleased with the natural gas they're getting from Transco-served utilities. They're calling on us to deliver more every year, offering the steady demand of the most people with the greatest need for clean fuel.

HELPING DEVELOP A MARKET FOR TEXAS-LOUISIANA NATURAL GAS

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

of the slot and the block which bears against the pin.

A ½-inch pin, threaded on the one end and shaped into a crank handle on the other, is run through from the forward side of the pitman and screwed into the bar. By cutting the wooden block at an angle and equipping both it and the upper bearing surface with light steel plate material, tightening of the threaded crank will thrust the block downward against the pin. A large washer welded to the crank shaft, and which bears against a steel strap, prevents the crank from being drawn in as it is tightened.



Circular Openings Simplify Regular Wrist Pin Greasing

A round access hole cut into the wire mesh fencing on either side of the pumping unit can save not only the cost of otherwise necessary doorways or removable panels, but the time of the pumper when wrist pin bearings periodically are greased. When the mesh panels are assembled and in their final position, a convenient point is selected and a round hole some eight inches in diameter is cut out of the mesh. A circular disc having a diameter two or three inches greater than that of the hole then is installed as shown in the photograph.

The pumper, in greasing the bearings, stops the unit so that wrist pin is opposite, or approximately so, to the openings. On completion of the job and, on withdrawal of the gun, the protective disc again falls in place without need of latches or springs.

What's Happening

among MEN in the INDUSTRY

Warren W. Mankin, who has been district engineer and head of the Engineering department for the Oil Conservation Commission in Santa Fe, N. M., for the past two and one-half years, has resigned to join the staff of **Aztec Oil & Gas Company,** Dallas, as chief engineer. Before joining the OCC staff, Mankin worked as an engineer for The Texas Company for ten years.

•

H. L. Hesselmeyer was appointed to the position of manager, gas, Producing department, **Standard Oil Company of California, Western Operations, Inc.** Hesselmeyer succeeds **R. E. Clarke** who recently was named manager, natural gas utilization. **J. E. Mahle** has been named drilling superintendent, Northern division, Taft, succeeding **C. V. Reynolds.** Reynolds retired after 42 years with the company. **Carl Johnson** becomes assistant drilling superintendent, Northern division, Taft, filling the position Mahle vacated. Johnson formerly served as drilling foreman.

•

George L. Buckles Company has been formed as a consulting firm with offices in Monahans, Texas, by **George Buckles.** The new company will specialize in water-flooding. Buckles has had 25 years production experience, having been assoociated with The Pure Oil Company for 16 years in Oklahoma, Texas, Illinois, Ohio and West Virginia. He joined Forest Oil Corporation in 1948 as superintendent in charge of waterflood operations in West Texas. He has been associated with the consulting firm of Buckles and Hostetler since 1951.

George Buckles

•

Sohio Petroleum Company made the following changes. **R. H. Mansfield,** formerly staff geophysicist, Foreign Operations division in Oklahoma City, was transferred to the Northwest division in Billings, Mont., as division geophysicist. **H. C. Talley, Jr.,** formerly staff geophysicist, headquarters exploration in Oklahoma City, was transferred to Foreign Operations division in Oklahoma City. In his new position, as staff geophysicist, he will supervise the joint Venezuela Geophysical Interpretative group. **C. C. Sellers,** formerly superintendent of geophysical operations, Houston, was transferred to Oklahoma City as staff geophysicist, headquarters exploration. **C. F. Wendenburg,** geophysical laboratory supervisor in Houston, will temporarily assume the duties, responsibilities and authority of superintendent of geophysical operations.

F. Hugh Wilson

Henry H. Neel

Henry H. Neel has been named to the newly created post of manager of foreign exploration of **Tidewater Oil Company.** He will be responsible for the planning, coordination and operation of the company's oil and gas exploratory program abroad. Tidewater's foreign interests presently include Guatemala, Iran and Turkey. Neel joined the company's exploration staff in Ventura, Calif., in 1942. In 1955 he became western division exploration manager, with headquarters in San Francisco where he will continue to be located in his new assignment. **F. Hugh Wilson** has been appointed exploration manager of Tidewater's Western division to succeed Neel. He will be responsible for all Tidewater's exploratory, geological and geophysical activities in the seven western states and report to Vice President **T. L. Wark.**

•

A. E. Woerheide, Jr., has been named chief engineer for **Stekoll Petroleum Company,** Dallas. He was formerly vice president in charge of production and drilling for Byrd Oil Company from 1952 to 1957. From 1936 to 1952 he was employed by Shell Oil Company as division exploration engineer in the Gulf Coast and Mid-Continent areas. As chief engineer for Stekoll, Woerheide will be in charge of the engineering on development work, reservoir studies and exploration.

A. E. Woerheide, Jr.

•

The Texas Company announced the election of four senior vice presidents and three vice presidents. The new senior vice presidents are: **Claude B. Barrett,** formerly vice president for the company at Houston, who becomes senior vice president and chief executive officer at Houston. **Everett R. Filley,** formerly vice president in charge of the Producing department-domestic, who becomes senior vice president in charge of Texaco's worldwide producing interests and activities. **Theodore**

CUT STUCK SAND LINES INSIDE TUBING

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M. M. Kinley Company, Licensees

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Hudson-Eads, Inc. 2-5331
BAY CITY, TEXAS
J. P. Graham.....CI 5-4526
BEAUMONT, TEXAS
Assoc. Eng. & Eqpt., Inc.....TE 5-7048, ZF 6-2023
CASPER, WYOMING
C. A. White.....3-5264
FORT MORGAN, COLORADO
C. A. White.....819
GLENDIVE, MONTANA—C. A. White..EM 5-3833
HOBBS, NEW MEXICO
Horne Well Service Co.....3-5396
HOUSTON, TEXAS
Assoc. Eng. & Eqpt., Inc.....CA 5-1103
KILGORE, TEXAS—B. M. Davis.....5541
LAFAYETTE, LOUISIANA
Assoc. Eng. & Eqpt., Inc.....CE 5-6770
LIBERAL, KANSAS—Rainbo Service...Main 4-3598
MIDLAND, TEXAS
Lucoous Service & Eqpt. Co.....MU 2-1631
NEW ORLEANS, LOUISIANA
Assoc. Eng. & Eqpt., Inc.....VE 5-4983
OKLAHOMA CITY, OKLAHOMA
Rainbo Service Co.....ME 4-2131, ME 2-3045
PETTUS, TEXAS
Eddie Jones Eng. Co., Pettus 18; Beeville, FL 8-1218
WHITTIER, CALIFORNIA
Kline Wire Line Co.....OX 3-2731
WICHITA FALLS, TEXAS
Hudson-Eads, Inc. 2-3767, 2-8584, 3-4890

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Composite Catalog, Page 3419

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A. Mangelsdorf, formerly vice president, becomes senior vice president in charge of the company's worldwide refining interests and activities. **James T. Wood, Jr.,** formerly vice president for the company at Los Angeles, who becomes senior vice president and chief executive officer at Los Angeles. The new vice presidents are: **J. Howard Rambin, Jr.,** formerly assistant to the vice president in charge of the Producing department-domestic, who succeeds Filley as vice president in charge of that department. **J. B. Christian,** formerly chairman of the board and managing director of Trinidad Oil Company, Ltd., a Texaco subsidiary, who becomes vice president in charge of Trinidad operations, with headquarters in New York. **L. C. Kemp, Jr.,** formerly general manager of Texaco's Petrochemical department, who becomes vice president in charge of that department. Kemp will be responsible for the company's interests in the field of petrochemicals.

•

Seneca Oil Co., Tulsa, has elected three new members to its board, increasing the membership from five to seven. The new members are **Ernest W. Veigel,** president of the Rochester Business Institute; **H. C. Wynne,** independent oil operator, and **James D. Kersey,** Seneca's chief geologist. Holdover board members are **J. Fred McCown,** president; **J. E. Johannesen,** Oklahoma City oil and insurance man; **B. C. Campbell,** Salt Lake City mining and oil operator, and **Edward M. Bynum,** Seneca's secretary-treasurer and a member of the Oklahoma City law firm of Ames, Daugherty, Bynum and Black. **George R. Pietch,** president of Aberdeen Petroleum Corp., has resigned from the Seneca board.

•

Neese Exploration Company of Houston announced the association of **Jonathan W. Phillips,** consultant, as chief geophysicist in charge of gravity interpretation. Before joining Neese Exploration Company, he was with Schlumberger Well Surveying Corporation and later a geophysicist for Sohio Petroleum Company. After leaving Sohio, he was president of his own consulting firm until June of this year.

Jonathan W. Phillips

•

Gulf Oil Corporation announced that four new positions of district manager have been created. These managers will have their headquarters in Houston, New Orleans, Shreveport, and Jackson, Miss. The territories served by these men will correspond to the areas formerly called zones. **W. A. Shellshear** will be the new Houston district manager, **W. W. Ramseur** the new manager in Jackson, **R. A. Payne** the new manager in New Orleans, and **B. W. Haywood** the new manager in Shreveport. The district managers will be in charge of all exploration and producing operations, as well as services activities, in their respective districts. In addition to the district Managership appointments, the following appointments within the various districts were named.

J. P. Weichert, presently classified as zone superintendent of production at Pierce Junction, was appointed district production manager, Houston district. **M. C. Coleman,** assistant zone superintendent of production at Laurel, Miss., was appointed district production manager, Jackson district. **W. B. Hopkins,** zone superintendent of production of the Shreveport zone, was appointed district production manager, New Orleans district.

F. J. Mikeska, assistant zone superintendent of production of the Shreveport zone, was appointed district production manager, Shreveport district. **T. R. Deen,** presently classified as zone exploration manager, Houston zone, is appointed district exploration manager, Houston district. **J. L. Herndon,** zone exploration manager, Shreveport zone, was appointed district exploration manager, Jackson district. **H. D. Ritter,** zone exploration manager, New Orleans zone, was appointed district exploration manager, New Orleans district. **R. C. Howard,** zone geologist, Houston zone, was appointed district exploration manager, Shreveport district. **N. B. Martin,** staff assistant to division production manager, Houston Production division, was appointed district services manager, Houston district.

D. R. Carmichael, assistant division clerk-Production department, Houston Production division, was appointed district services manager, Jackson district. **J. A. Austin,** zone clerk, New Orleans zone, was appointed district services manager, New

ARCCO
NOW SPECIFIC GRAVITY RECORDING OF LIQUIDS AT ANY DISTANCE
RECORDING TRANSMITTER
Accurate long-distance transmission of specific gravity recordings is no longer a problem with any of the new RMT Models of Arcco-Anubis Recording Gravitometers for recording and transmitting liquid gravity records. These instruments combine the mechanism of the standard Arcco Liquid Gravitometer with a metameter telemeter transmission system which records and transmits the specific gravity record to control room or other remote location. The interconnecting line may be any two-wire electrical circuit or its equivalent: private wires, telephone circuits, carrier current channels, or radio (VHF or UHF).
The range of the standard instrument is .15 or larger, but instruments with ranges of .10 or .05 can be supplied. Charts are available for more than 75 different ranges of Specific Gravity or Degree A.P.I. Special ranges can be furnished at slight additional cost. Request Bulletin No. 111-R3 for complete details.
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PUTS MORE LIFE IN SUCKER RODS

100% inspection guarantees perfect threads

Expert AXELSON inspectors test *both ends of every sucker rod* with three precision thread gages. Their job is to assure perfect threads – preventing sucker rod failures that result in expensive pulling jobs and down-time.

Each rod is checked for accuracy with "Go," "No-Go" and "Standoff" thread gages. In turn, these instruments are checked daily for accuracy against master API gages.

The moment a rod comes off the threading machine, pin threads are carefully inspected to maintain constant control over machine performance. Seconds later threads are coated with a heavy protective compound to prevent rust and corrosion . . . a thread protector is screwed on at one end and a Parkerized coupling with a plug added to the other. After its seventh and final inspection, another AXELSON sucker rod is ready to go to work. *For complete sucker rod comparison data, write for Chart PW10-PS9A.*

In 59 years of manufacturing equipment for the petroleum industry, AXELSON has pioneered many methods for putting more life in sucker rods:

METALLURGICAL CONTROL OF RAW MATERIALS . . . the first step in quality control.

HEAT TREATMENT . . . to insure uniform grain structure, strength, shock resistance.

ABSOLUTE STRAIGHTNESS . . . checking and rechecking after passing through a Medart bar straightener.

FORGING . . . to exact alignment with precision forging dies.

CLEANLINESS . . . complete removal of "scale" by shot blasting.

PAINTING, STORAGE AND SHIPPING . . . the important final steps in manufacture.

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Division of U.S. Industries, Inc.
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Every AXELSON sucker rod *is checked at both ends with three thread gages. Protective coating, coupling and cap are added immediately after inspection to protect threads and prevent rust or corrosion.*

The threads of AXELSON *Parkerized couplings undergo the same rigid inspection as rod pin threads. Accuracy of coupling and rod pin threads assures perfect alignment, tight joints with greatest bearing surfaces.*

Orleans district. **J. J. Mathis**, special assignments-Accounting department, Houston, was appointed district services manager, Shreveport district. **O. W. Crisman**, zone superintendent of production (offshore) at Morgan City, was appointed district production manager, Offshore district. **J. D. Nunnally**, zone geologist, New Orleans zone, was appointed district exploration manager, Offshore district.

Upon the effective date of this reorganization, the titles of the Houston Production division departmental managers will be changed as follows: The title of **L. H. Moore**, division production manager, will be changed to division production coordinator. The title of **G. O. Relf, Jr.**, division exploration manager, will be changed to division exploration coordinator. The title of **F. C. Anderson** will be changed from division comptroller and services manager to division comptroller and services coordinator.

•

William G. Cutler has been appointed manager of Production Operations and Reservoir Engineering department of **Pacific Northwest Pipeline**. Cutler replaces **L. G. Truby, Jr.**, who was recently designated general manager of production for Pacific Northwest. Cutler has been associated with Pacific since June, 1955, as a petroleum engineer. Also announced was the appointment of **T. A. Dugan** as division manager of Pacific Northwest's operations in the San Juan Basin. Dugan has been with the pipe line company since June, 1955. He will be located at Farmington, N. M.

B. W. Croft, assistant manager of **Mountain Fuel Supply Company's** Producing division at Rock Springs, Wyo., has been appointed manager of the Producing division. Since 1946 he has been employed by Mountain Fuel and has served successively as drilling foreman, assistant superintendent of production, drilling superintendent, general superintendent of production, and assistant manager of the Producing division.

B. W. Croft

•

George A. Clark was promoted to assistant general manager of **The Texas Company's** Producing department. It also was announced that **O. B. Hocker** will succeed Clark as assistant division manager, South Texas division of the Producing department. Both will be located at Houston. Clark was employed by Texaco as a geologist at Houston in 1929. Hocker's first job with Texaco was that of computer on a geophysical party operating out of Houston. He advanced to assistant division manager of the Geophysical division in 1950 and to head of the division in 1954. **T. L. Kunkel** has been promoted to chief geophysicist of **The Texas Company's** Producing department. He started with Texaco in 1934 and served as computer and party chief in geophysicial operations of the company. After several transfers and promotions, he was appointed supervisor of field operations, Geophysical division, in 1951, and in 1955 he was named assistant division manager.

•

Richard S. Stewart, vice president and assistant to the president of **The Standard Oil Company (Ohio)**, has been named vice president for production. Stewart will be responsible for all exploration and production operations of Sohio and its subsidiaries, reporting to **Charles E. Spahr**, executive vice president. Stewart will maintain his office in Cleveland, and **Rudy W. Edmund** has been named general manager for the Production department, to continue his headquarters in Oklahoma City, reporting to Stewart. In 1955, Stewart served a year as president of Iricon Agency, Ltd., representing nine American oil companies with crude oil production, refining and export rights in Iran. He joined Sohio as a power engineer in 1938, after six years' experience in refinery operations with The Texas Company in Texas.

Richard S. Stewart

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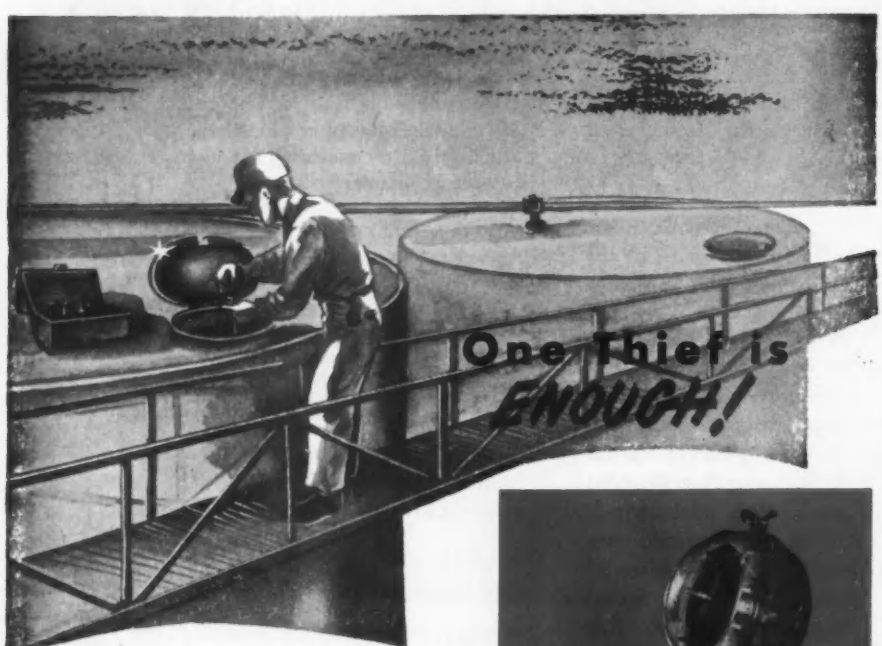
R. E. Graham has assumed the newly-created position of assistant district superintendent for **Pan American Petroleum Corporation** at Lubbock, Texas. Graham moves to Lubbock from Tulsa, where he had been aviation superintendent for the



Don't let vapor losses (or other thieves) steal you blind.

1. Corrosion of tanks. Reduced when correct pressure setting is maintained on all tanks in storage battery, and oxygen is excluded.
2. Gravity drop (premium of 2c per barrel) can be stopped. Many users of vapor control system have reported gravity increases after installation.
3. Volume losses (2½% per degree gravity drop). Very substantial savings have been reported.
4. Lifting costs. These costs can be cut, because with the gravity and volume losses stopped, every barrel produced is saleable.

The elimination of any one of these thieves will more than pay for the installation of an Enardo vapor control system.

The Enardo 770 "By-Pass" thief hatch valve shuts off from the vent line for vapor control. When the hatch is open the "By-Pass" controls the opening into the vent line, sealing off the rest of the tanks in the battery. This automatically holds the correct pressure settings and excludes oxygen. Holding the pressure in all tanks prevents large gravity and volume losses during normal working conditions. The 770 Series hatches feature "bottle-tight" seals and De-icer action gaskets.

Call, write or wire Enardo for additional information.

770 VAPO-GARD THIEF HATCH VALVE

770-BP VAPO-GARD THIEF HATCH VALVE

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company for the past 6½ years. Graham has been identified with the Pan American organization since 1931. In that year, he joined the company (then Stanolind Oil and Gas Company) at Kilgore, Texas. He transferred to Tulsa as aviation superintendent in 1950.

•

J. E. Kendall was appointed a vice president of **Blanco Oil Company.** Kendall will be in charge of land, geological and exploration. He has been associated previously with Kenneth A. Ellison, consulting geologist of Oklahoma City, The Big Chief Drilling Co. and Phillips Petroleum Co. While with Phillips, he served in the Land and Geological department of the company at Evansville, Ind., Shreveport, La., and Houston and with the home office in Bartlesville, Okla.

Phillips Petrolcum Company has promoted **R. E. McPhail** to southeast regional manager in its land and Geological department. McPhail, with headquarters in Bartlesville, Okla., replaces **J. E. Kendall,** resigned. McPhail was formerly assistant manager and regional geologist of the southeast region, which comprises divisions with offices at Houston and Corpus Christi, Texas, Jackson, Miss., Lafayette and Shreveport, La., including offshore operations. **H. R. Segnar** has been promoted to southeast regional geologist in Bartlesville from his former position of division exploration geologist at Oklahoma City. **E. F. Wroblewski,** who has been district exploration geologist at Ardmore, Okla., succeeds Segnar, and **M. A. Vaughn,** previously assistant division exploration geologist at Oklahoma City, replaces Wroblewski at Ardmore.

R. E. McPhail

•

C. A. Watts, consultant, Corpus Christi, Texas, has joined **North Central Oil Corporation,** Houston, as chief engineer. He was with Shell Oil Company until 1953, and when he resigned, was division reservoir engineer, located in Corpus Christi.

•

Lion Oil Division of Monsanto Chemical Company, has announced that **H. Harold Bible** is the new vice president and assistant general manager of the division. Bible, who has been director of manufacturing since 1955, joined Lion at El Dorado in 1942 as synthesis supervisor at Ozark Ordnance works which was operated by the company for the Army Ordnance department. Prior to employment by Lion he was with Humble Oil & Refining Company. Bible's present responsibilities as director of manufacturing will be taken over by **J. B. Rogerson,** Lion vice president in charge of manufacturing, engineering and development.

•

Jed B. Maebius has been appointed to the newly-created position of senior geologist for domestic exploration in Tidewater Oil Company's headquarters Exploration department in San Francisco. Before joining Tidewater, Maebius spent 20 years with the Gulf Oil Corporation Exploration department, holding various posts including chief geologist and then assistant exploration manager in Gulf's Tulsa division. For the past two years he has served as a consulting geologist in Tulsa.

Jed B. Maebius

•

Max F. Powell has recently become associated with **Russell Maguire,** oil producers in Dallas, as chief engineer in charge of operations in Texas, Oklahoma, Kansas, Louisiana, Mississippi and New Mexico. Powell has wide experience with the Railroad Commission of Texas and other segments in the oil industry. For a year prior to joining Russell Maguire, Powell was a consulting petroleum engineer in Austin.

•

Jack H. Abernathy, president of the American Association of Oilwell Drilling Contractors, has been elected director-at-large of the United States Chamber of Commerce. He is also vice president of Big Chief Drilling Company.

•

Roland C. Smith, geologist, has joined the staff of **Wm. Ross Cabeen & Associates** in Dallas. Before joining Cabeen, Smith was assistant to the regional exploration manager, Dallas Eastern region of the Atlantic Refining Company. **Joseph C.**

For Longer Service . . . Greater Joint Strength . . .
More Footage at Lower Cost—

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Drilling Stems

with Forge Hammer-Welded, Fully Heat-Treated, Precision Machined Box and Pin Joints . . .

SPANG DRILLING STEMS are made of machine straightened special bar quality open hearth steel, of the right analysis to assure the greatest vibration dampening effect. Box and Pin joints are hammer-welded, fully heat-treated, and have precision machined threads to provide the strongest, most wear-resistant joints obtainable. As a result SPANG DRILLING STEMS, with high strength joints, give longer than average service and drill more footage at lower cost.

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. . . of the same carbon steel analysis as those integral with original stems are available in all sizes, lengths and joint combinations for forge or electric welding to stems when renewal is required.

For complete information on Stems and Replacement Boxes and Pins, and for FREE CATALOG of other SPANG CABLE TOOLS, consult your nearest SPANG DEALER or write direct to:

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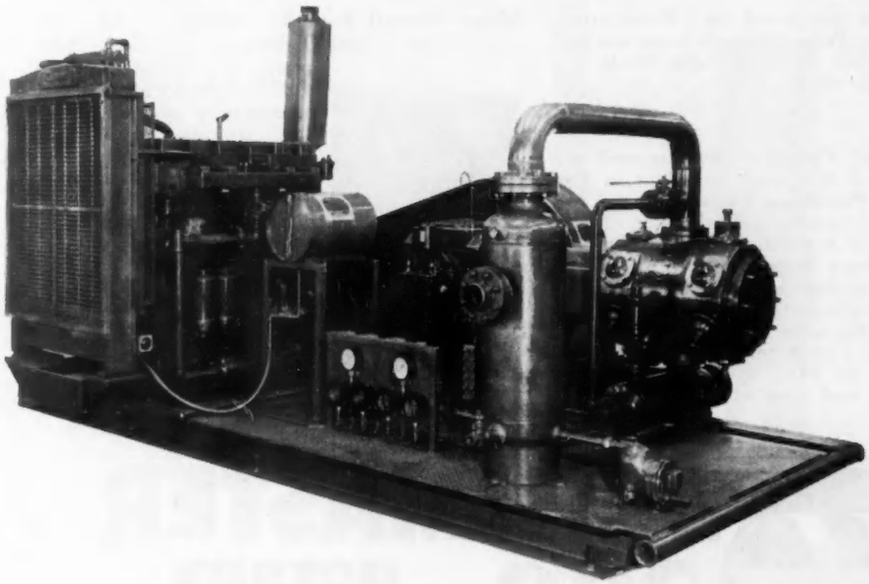
For over 60 years Manufacturers of Spang Weldless Jars and a Complete Line of Cable System Drilling and Fishing Tools for Oil and Gas Wells, Water Wells, Prospect Drilling and Shot Blast Holes.



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The type "ESH" Compressors are completely new. In them have been incorporated features that assure continuous, low cost operation. They are adequately valved with type "A" CHANNEL Valves with "double life" seats in low and medium pressure cylinders and the dependable type "K" valves in the high pressure units.

Every installation is engineered to meet specific, individual well conditions—and is completely fabricated to give trouble free performance.

These features mean profit and satisfaction to you:

Completely sealed frame.
Sealed distance-piece.
Full-floating aluminum bearings.
Force-feed lubrication with full flow filter.
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Low-oil-pressure protection.
Aluminum crosshead shoes.
Bored crosshead guide.
Full-floating metallic packing.

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TEXAS: Alice, Corpus Christi, Victoria, McAllen, Bay City, Columbus, Barbers Hill, Liberty, Beaumont, Kilgore, Odessa, San Antonio. LOUISIANA: Lake Charles, New Iberia, Houma, Harvey, Shreveport. NEW MEXICO: Hobbs.

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HOUSTON, TEXAS

Roberts has also joined the Cabeen group in its Lima, Peru, office. Roberts was formerly district geologist with Shell Oil Company in Corpus Christi, Texas.

•

C. B. (Pat) Caruthers has assumed the position of field superintendent at **Pan American Petroleum Corporation's** Yates area, headquartered at Iraan, Texas. Caruthers is succeeding **F. H. Clements,** who has been transferred to an assignment in Pan American's Venezuelan operations. Caruthers returns in his new capacity to the same Yates area where he first joined Pan American more than 20 years ago. In 1936 he began work as a roustabout and apprentice engineer at Yates.

Major General John R. Gilchrist, USAF (ret.), has joined **Tidewater Oil Company** as administrative vice president for organization planning and development. Until his retirement from the Air Force on June 26, General Gilchrist was both commander of the Air Force Finance Center in Denver and assistant comptroller of the Air Force. In his post with Tidewater, a newly-created one, he will make his headquarters in San Francisco. He was assistant Air Force comptroller during the past year.

John R. Gilchrist

•

W. C. Dennis has been named chief geologist for **Lion Oil Company,** a division of Monsanto Chemical Company, Dennis, who has been regional geologist for the company at Shreveport, La., since 1952, will assume his new duties at Lion's production and exploration offices in Houston. He replaces **E. D. Klinger** who recently elected early retirement and has entered the consulting field, with offices in Shreveport. Dennis was originally employed by Lion in December, 1941, as geologist and advanced to district geologist at El Dorado prior to his move to Shreveport.

•

John E. Rouse has been elected new president of **Utah Southern Oil Company. George T. Hansen,** who founded the company in 1921 and has since served as its president, was elected to the newly created position of chairman of the board. **George T. Hansen, Jr.** was named vice president in charge of operations, and **De Witt Van Evera,** to continue as treasurer; and **M. D. Paine,** as secretary. The new president in 1953 retired early after serving for more than 30 years with the Standard Oil Company of Indiana interests, his last position being as vice president in charge of operations for Stanolind Oil Company, its producing subsidiary. During World War II he served as a member of the Secretary of the Navy's Committee on Public Works Projects, generally known as the "Hill" committee. It acted for Secretary Forrestal in authorizing and approving construction for all the Navy's land facilities. He received the Navy's award for Distinguished Civilian Service.

John E. Rouse

•

Arthur R. Erickson has been named exploration manager for **Northern Natural Gas Producing Company,** a wholly-owned subsidiary of Northern Natural Gas Company of Omaha, Neb. He was formerly chief geologist. As exploration manager Erickson will direct the company's exploration activities in the U. S. and Canada, reporting to **J. M. Barton,** vice president of the producing company. Erickson joined Northern in 1951 as chief geologist after ten years service with Phillips Petroleum Company as a geologist.

Arthur R. Erickson

•

Standard Oil Company of California's research branch, California Research Corporation, has begun construction on a new

DRILLMASTER 300 P.A. ROTARY DRILL

QUICKER DRILLING/ NO FLOODING/

The Drillmaster Power-Arm Drill represents an advanced approach to the truck/trailer mounted prospecting drill problem. The rotation of the drill pipe and bit is by means of motors mounted in a gear box at the upper end of the drill string. The rotary head, as this gear box is called, is moved up and down with the drill string by means of an arm which is pivoted at its front end.

The arm, and thus the rotary head which is mounted at the rear of the arm, is raised and lowered by jacks mounted a short distance to the rear of the arm front pivot point. In order that the rotary head shall travel up and down on a vertical straight line, a system of links is attached towards the front end of the arm, and to the front frame (about the top end of which the front end of the arm pivots); these links move the front pivot point of the arm forwards and rearwards thus maintaining the position of the rotary head above a fixed point. The system of links is a modified form of the well known "Scott-Russell" straight line motion and causes the rotary head to travel on a vertical straight line over the length of movement permitted by the jacks.

A guide mounted vertically under the rotary head, and a short distance above the ground, holds the first length of drill pipe, and the bit, vertically and prevents the turning bit from wandering at the commencement of the hole. As drilling progresses the guide serves to reduce whip in the drill string and so assists in maintaining the drilling of a straight hole. Send for illustrated bulletin.

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Here are a few Halliburton products used in multiple-stage cementing that have helped lengthen the lives of thousands of wells...

HALLIBURTON'S "DV" MULTIPLE STAGE CEMENTER ...for primary cementing on outside of casing string. With special plugs and a baffle, two and three-stage cementing on same string is possible ...in continuous operation or at desired intervals... using two or three different types of materials. Designed for positive fluid shut-off by means of hydraulically operated dual sleeves and high pressure packing.

Better Cementing means Longer Well Life

HALLIBURTON CEMENT BASKETS...often used below "DV" Multiple Stage Cementer to retain cement and protect weak formations by reducing slurry loss of formation breakdown. Run on outside of casing or liner at point above weak or porous formations. After cement is pumped, basket opens, helps support heavy cement columns until they take initial set.

HALLIBURTON'S S-3 CASING CENTRALIZERS... with heat-treated, lap-welded springs to minimize channeling, aid in uniform placement of cement around casing. Cut later remedial expenses. Specially designed Heavy Duty and Slim Hole types where needed.

HALLIBURTON'S HOWCOGEL... a high yield bentonite used in cement to reduce slurry weight and increase slurry volume. Reduces slurry cost...When mixed with mud, provides low fluid loss. Reduces filter cake thickness and has outstanding gel-strength properties. A good suspending agent for cuttings or weighting materials.

CEMENTING SERVICES

251 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG

$500,000 addition to its La Habra laboratory facilities to provide office and laboratory space for expanded oil field research activities. The two-story reinforced concrete structure will be occupied by 80 employes. It will house the petrology and well completion laboratories, and a computing center in which theoretical and experimental data will be put in a form for processing on large-scale computing machines such as the IBM-704. The 16,000-square foot building will have an attractive lobby with adjoining offices and a divided conference room.

•

Tidewater Oil Company has opened a district production office in the Hales building, Oklahoma City. **H. D. Spires** is being transferred from Chickasha to Oklahoma City as district superintendent. **W. E. LaRoche,** formerly area engineer at Hobbs, N. M., moves to Oklahoma City as district engineer. The new district office will be responsible for operations in Oklahoma, Kansas and north Texas.

•

Russell E. Hayward was appointed chief geologist for Canadian operations with offices in Calgary, of **Alex W. McCoy Associates, Inc.,** petroleum consultants. Hayward formerly was assistant zone exploration manager for Gulf Oil Corporation in Oklahoma City, Okla., before joining McCoy. He was with Gulf for six years as a geologist in Denver, Casper, Wyo., Tulsa and Salt Lake City. Before joining Gulf, Hayward spent five years in Colombia, South America, and was a party chief with Socony Mobil Oil Co.

•

Robert Dyk has been appointed to fill the newly-created post of chief geophysicist of **Tidewater Oil Company.** Dyk came to Tidewater from Geophysical Service, Inc., Denver, where he was manager of that concern's Mid-Continent division. From 1947 to 1951 he served as geophysical supervisor for General Petroleum Corporation at Bakersfield, Calif. Before that, he was associated with Western Geophysical Company in Los Angeles.

Robert Dyk

•

R. O. Rhoades has been elected a member of the board of directors and of the executive committee of **Gulf Oil Corporation.** He also will continue as a senior vice president and chairman of the company's administrative committee. Rhoades joined Gulf in 1926 as a geologist and went to Colombia, South America, on his first assignment. Upon completion of this work, he was sent to the Middle and Far East and spent four years in the Netherlands East Indies. Rhoades was elected a vice president of Gulf Oil Corporation in 1951 and in 1953 was placed in charge of the company's world-wide exploration and production activities. He was designated a senior vice president and a member of the administrative committee a year ago.

•

The Texas Company announced the appointment of **John H. Dea** as assistant to the president. Dea has been assistant manager of the Sales division of Texaco's Foreign Operations department - Western Hemisphere and West Africa since November, 1956. He joined Texaco in 1937 as an industrial salesman in the Minneapolis Sales division.

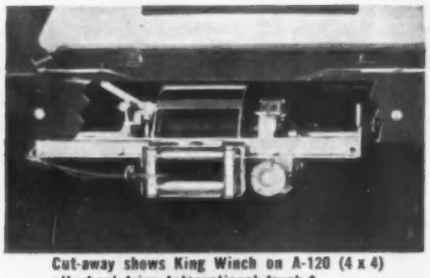
John H. Dea

•

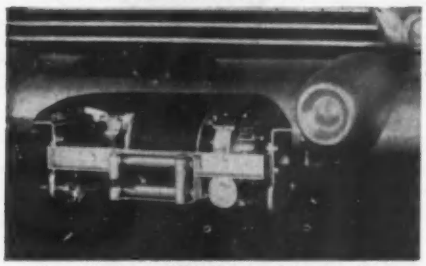
Occidental Petroleum Corp. announced that **Armand Hammer,** president of United Distillers Corp. of America and a director of the First Bank & Trust Co. of Perth Amboy, N. J., has been elected president of Occidental. Two additional members of the Board were elected in the persons of **Charles Schwartz,** a director of North Western Production Corp. of Houston, a division of the El Paso Natural Gas Company and **Arthur Groman,** attorney and member of the Los Angeles law firm—Mitchell Silberberg & Knupp.

•

Robert D. Haack was appointed superintendent of the new **Standard Oil Company (Indiana)** terminal at Escanaba, Mich. **Earl R. Swett,** superintendent at Peoria,



Cut-away shows King Winch on A-120 (4 x 4) all-wheel-drive International truck.*



King Winch on GMC Truck. Cut-away shows underslung mounting, featuring new hi-tensile strength design.

P.T.O.-Driven King Winch on Willys Jeep.

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. . . for Willys Jeeps, 4 x 4 trucks and station wagons, International, GMC, Chevrolet, Ford, Land Rover and other vehicles.

COMPLETE, READY-TO-INSTALL FRONT-MOUNT WINCH ASSEMBLIES FEATURE:

- winch side arms to reinforce truck frame
- bronze-bushed, 4-way cable guide rollers
- cable drum guard
- heavy-duty pipe bumper
- needle-bearing, universal-joint spline-shaft drive assembly
- Timken bearings on worm

King Winches keep you moving through the most difficult terrain . . . you get action where there's no traction with dependable pulling power. King power winches have pulling capacities of 8,000 to 19,000 lbs.

*King Winches for International Harvester trucks are available through International distributors and dealers.

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★ Protection ★ Safety
★ Comfort ★ Convenience

Roll-down windows, full opening . . . full panel-board head lining and masonite door lining . . . safety glass throughout . . . all-steel welded construction . . . door locks.

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FULL AND HALF CABS

Full Cab and Model 151J King Winch Illustrated.

Koenig Jeep cabs and King Winches for Willys vehicles are available through Willys Motors, Inc., and Willys-Overland Export Corp. distributors or dealers. Write for free descriptive literature.

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QUICK

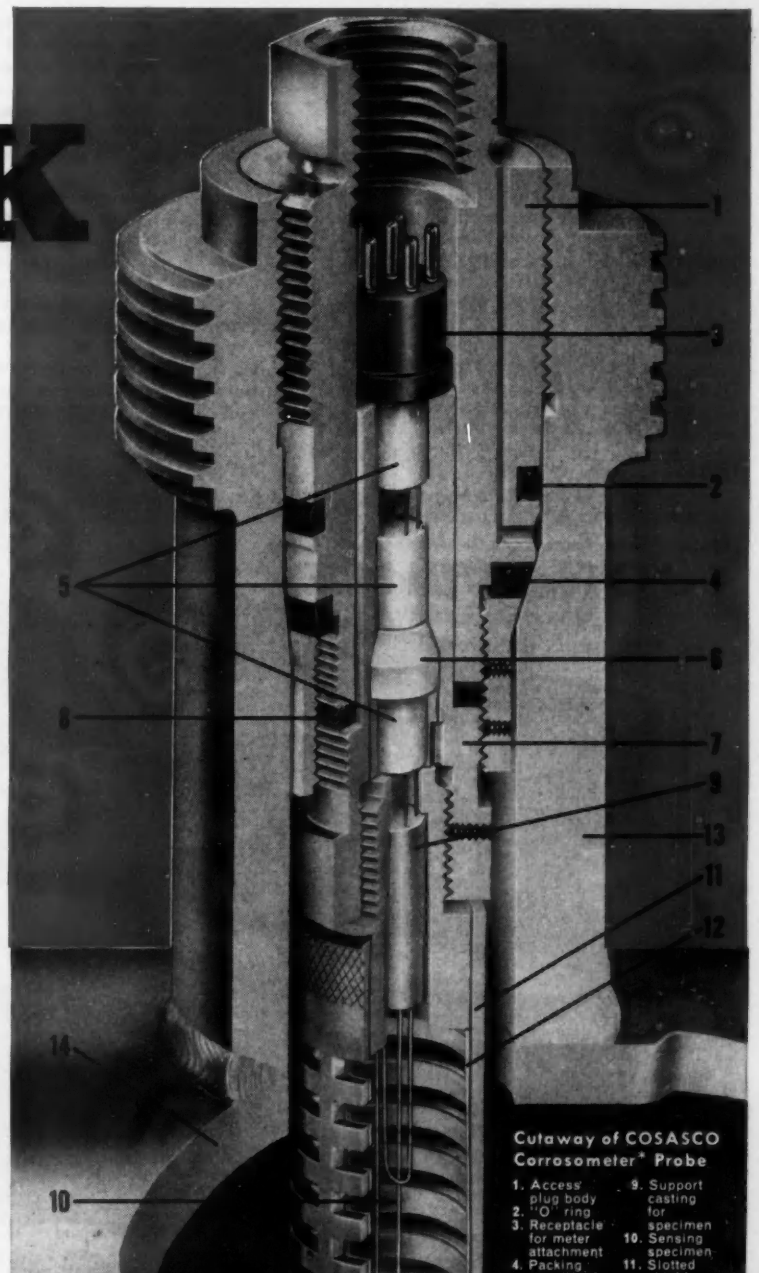
...corrosion readings while on stream...at full operating pressure

Corrosion engineers can now quickly detect and measure rate of corrosion of surfaces within pipe lines, processing vessels and receptacles, without interfering with operations...with this new COSASCO Corrosometer* Probe. Wherever a COSASCO *Access* Nipple can be installed, this probe can be inserted against full operating pressure, for sensing corrosion.

With a special meter connected to the probe, corrosion readings in increments of microinches can be made in as short an interval as 30 seconds. Effects of remedial programs can be determined in days instead of months!

Readings are based on the increase in electrical resistance of a metal specimen as corrosive attack reduces electrical conductivity. Accurate readings are obtained when the specimen is of the same metal as the surface under study.

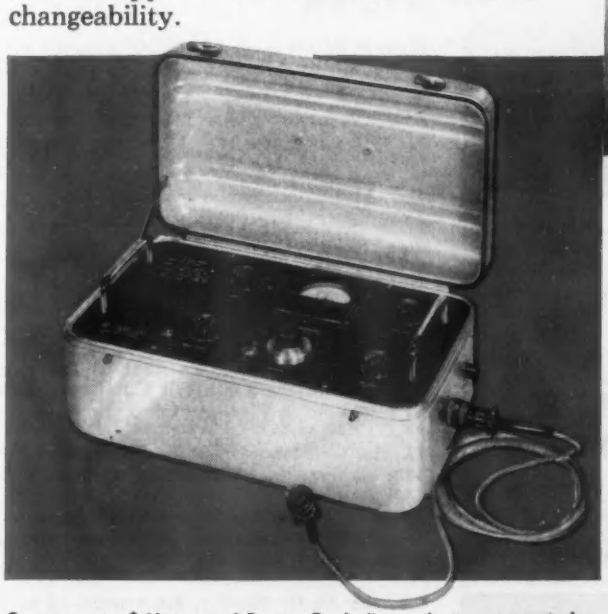
The Corrosometer* Probe is one of several specialized COSASCO *Access* Plugs adapted to corrosion investigation. They include coupon-holder, water-sampler, thermocouple, and hydrogen-probe plugs. All can be supplied in the same OD for interchangeability.



Items 3 to 12 inclusive comprise a replaceable insert and can only be bought as such.

Cutaway of COSASCO Corrosometer* Probe

1. Access plug body
2. "O" ring
3. Receptacle for meter attachment
4. Packing ring (Hard Rock)
5. Ceramic spacers
6. Pressure seal
7. Probe housing
8. Packing washer (Hard Rock)
9. Support casting for specimen
10. Sensing specimen
11. Slotted shield
12. Insulating sleeve
13. Access Nipple (Welding type)
14. Wall of vessel or pipe line



Corrosometer* Meter and Power Pack, line or battery operated.

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If you have an entry-against-pressure problem, COSASCO engineers can help you overcome it. Send details and blueprints depicting your problem and the COSASCO solution will be supplied promptly and without any cost to you whatsoever. *Write directly to* COSASCO Division of Perfect Circle Corporation, at the address below.

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11655 McBean Drive, El Monte, California *TRADE MARK

Export Office: 3631 Atlantic Avenue, Long Beach, California

Ill., since 1951, succeeds Haack as superintendent at the Milwaukee, Wis., terminal, and **Dwight Browning**, district pipe lines superintendent at Chicago since 1955, replaces Swett. Haack will be in charge of the 11-million-gallon Lake Michigan marine terminal now under construction at Escanaba which is expected to be in operation by the close of the navigation season this year. The terminal will have storage facilities for improved year-round products delivery to 22 communities it will serve in six Upper Peninsula counties.

•

Raymond E. Ming, consulting geologist, announced the opening of his office at 750 San Jacinto building in Houston. He was formerly chief geologist for **David L. Gordon** in Houston.

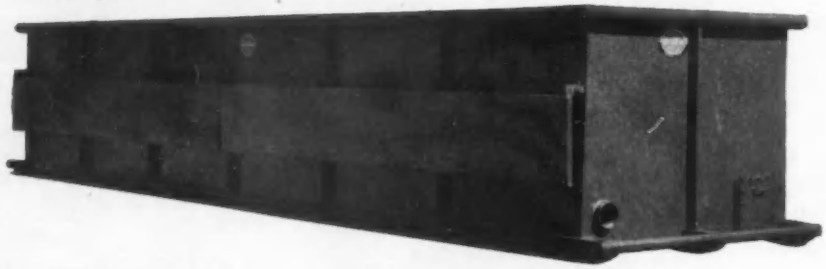
Midwestern University, located in Wichita Falls, Texas, has announced the appointment of **Maynard M. Stephens** as dean of the School of Petroleum and Physical Sciences. In 1953 Stephens joined the firm of Drill Well Oil Company, Wichita Falls, a drilling, oil producing and waterflooding organization operating in the Wichita Falls-Abilene area. He is now the owner of the consulting firm Associated Petroleum Engineers, which operates, manages and engineers water-flooding projects in Texas and Oklahoma. He is also an independent oil producer. He will continue in the consulting business.

•

James B. Whatley, formerly with Gulf Oil Corporation for the past six years, has opened offices as a consulting geologist in the Chronicle building in Houston.

JOE STINE

Portable Steel Mud Pits



Safety, economy, and ease in handling drilling mud are major features. They reduce mud losses. Prevent contamination. Permit easier control over weight and viscosity. Provide better and faster means of mixing weighting materials. Standard pits, 6 feet deep, 30 feet long, 7'6" wide. Capacity, approximately 230 barrels. Bottoms of ¼" steel plate; sides, 3/16" or ¼". Heavy reinforcing—3" channel iron ribs on 36" centers—provides strength and rigidity along the sides. Skid-mounted; pits may be hauled on any standard oil field trailer. Special Stine Mud Pits with valves, shale shakers, mud guns, baffles and other features also available.

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DEATHS

Herbert H. Reed, 59, leasing supervisor, Exploration department, Standard Oil Company of California, died in Los Angeles July 6. Reed had been with Standard for 37 years, of which the last 26 were spent in Los Angeles.

Worth B. Andrews, 75, mining engineer and oil operator, died June 26. He was a member of the American Institute of Mining and Metallurgical Engineers. He had been active in Texas since 1918, first in Fort Worth and since 1943 in San Antonio.

Hugh Alan Bardeen, 70, died July 14 in a Hollywood, Calif., hospital. He was president of the Bardeen Oil Company.

William C. Adams, 65, consulting geologist for Deep Rock Oil Corp., died July 12 in a Tulsa hospital. Adams had been a consulting geologist for oil firms in Tulsa and Houston since the middle thirties after serving for about 15 years as chief geologist for Deep Rock.

Henry H. Day, 70, died July 13 at his home in New York City. In the 1920's he was vice president of Sinclair Exploration Co., and had served as an oil scout for Sinclair.

Orville Harden, 63, died August 17. He was former vice president and vice chairman of the executive committee of the Standard Oil Co. of New Jersey and retired in 1953.

Delos Wells Woodward, 87 retired oil field driller, died August 19. Woodward retired from Standard Oil Company in 1945.

Frank M. Britain died August 15 in San Antonio, Texas. He was a retired motor equipment superintendent for Gulf Oil Corporation.

Armor Archbold, 48, died July 21 at Oban, Scotland. Archbold was connected with Standard Oil Company. His father, the late John D. Archbold, was president of Standard.

Russell Brinneman, 61, director of the educational program for the Supply and Transportation department of Phillips Petroleum Co., died July 21.

Charles William Ihrig, 83, retired Tulsa oil man, died July 23. Ihrig retired from the Mid-Continent Petroleum Corp. in 1944, after 26½ years with the firm.

J. P. Troll, 77, retired Tulsa and Pennsylvania independent oil producer, died July 28. He was also engaged in the oil field supply manufacturing business at one time.

John C. Askam, 63, assistant to the vice president of the Ohio Oil Company, died in his home in Findlay, Ohio, July 29.

C. Jim Creekmore, 51, died August 1. He was owner of the Creekmore Drilling Co.

Frank G. Wood, independent oil operator and drilling contractor of Great Bend, Kansas, died August 4.

Charles Austin Snyder, 80, retired oil producer of Sapulpa, Okla., died August 4.

COMPANIES in the News

STANDARD OIL COMPANY (NEW JERSEY) which this year is celebrating its 75th Anniversary will commemorate the event with a television show in color and black and white over NBC-TV October 13 in a coast-to-coast hook-up. Among the prominent stars who have been signed to appear are June Allyson, Jimmy Durante, Marge and Gower Champion, Brandon de Wilde, Bert Lahr, Eddie Mayehoff, Jane Powell, Kay Starr and Kay Thompson, with more to be announced later. Theme of the show will be the "Wonders of Today and the Promise of Tomorrow," interpreted via original material in song, dance, sketches and musical variety.

•

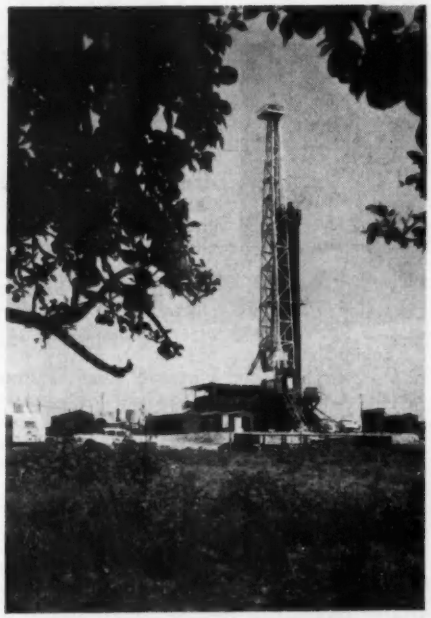
SHELL OIL COMPANY received the Department of Defense Reserve Award for "outstanding corporation" to the Reservists and Reserve activities. Making the presentation in the name of Secretary of Defense Charles E. Wilson, was Rear Admiral Milton E. Miles, commandant, Third Naval district. The ceremonies were attended by executives of Shell and high ranking military officers representing all branches of the Armed Forces. In making the award, Admiral Miles said Shell has frequently given assistance and advice to the Armed Forces in petroleum research. He also pointed out that Shell makes company facilities available for Naval Reserve use. The award was established in 1955.

•

TIDEWATER OIL COMPANY was presented the highest award of the National Safety Council recently in recognition of the accident prevention record made by Tidewater employes during 1956. The council's Award of Honor was accepted in behalf of the company's 9500 employes across the nation by **President David T. Staples. Iver C. Larson**, National Safety Council executive, made the presentation. Larson said the award was given because of the outstanding improvement in the company's accident rate in 1956. The lowered rate followed inauguration of an accelerated accident control program at Tidewater last year which involved accident prevention courses for supervisors, safety training sessions for all plant and field employes and strengthened local-level safety procedures.

•

NORTEX OIL & GAS CORPORATION, announced that a new district office has been opened in Midland, Texas. This new office located in the Patio Building, will take care of the increased exploration activities of Nortex in the West Texas area. Both **Jack Schmidt**, district geologist, and **Miles McDow**, district landman, were transferred to the Midland office from the Nortex home office in Dallas.



New Depth Record

Pushing through shale more than three and a half miles down, drilling bits on Magnolia Petroleum Company's No. 1 Sterba-Ordivician has already broken Oklahoma deep drilling records. The Caddo County deep test has 5100 feet of open hole, but no special problems have been encountered. A part-interest project, the well is being drilled by Big Chief Drilling Company, Tulsa.

AMERICAN TIDELANDS, INC., and **MARINE DRILLING, INC.,** have agreed to merge, forming a company with both inland and offshore marine drilling operations. The resulting corporation would retain the name Marine Drilling, Inc., and would have a projected net income of $1,224,000 annually. American Tidelands, Inc., with home offices in the Balter Building, New Orleans, owns a deepwater offshore drilling barge which is now being operated off the coast of Louisiana under contract to The Texas Company. Marine Drilling owns and operates four inland water drilling barges which are currently drilling in Louisiana coastal waters for the Gulf Oil Corporation. The company's home offices are in the City National Bank Building, Houston and **J. F. Corley** is president.

•

VICKERS PETROLEUM COMPANY, INC., of Wichita, Kansas, has purchased **KENT OIL COMPANY.** Kent was a marketing company with 23 service stations in Kansas and Nebraska, office facilities in Salina, Kansas, and various bulk stations.

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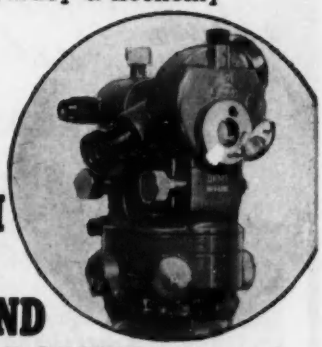

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what's Happening

among INDUSTRY ASSOCIATIONS

Houston Desk and Derrick Picks Sherrill as New Head

Miss Louis Sherrill, assistant secretary of the Brewster-Bartle Drilling Company, Inc., was elected president of the Houston Desk and Derrick Club for 1957-58. She will succeed Mrs. Ida Griffith to office at the club's installation of officers in October. At the present time she is the club's first vice president.

Louise Sherrill

Other officers elected to serve are first vice president, Mrs. Cleo Hopkins, Houston Slush Pump Repair Company, Inc.; second vice president, Mrs. Grace H. Haggard, Continental Oil Company; recording secretary, Miss Marie Gummelt, Crown Central Petroleum Corporation; corresponding secretary, Miss Patricia Jean Gallagher, Humble Oil & Refining Company; treasurer, Mrs. Lou Brown, Clegg & Hunt.

Elected as directors are Mrs. Chris Fowler of Reed Roller Bit Company, Miss Margaret Gust of Superior Oil Company, Mrs. Earlene K. Monroe of Butler, Miller & Lentz and Miss Rosa Lea Spaugh of King & Heyne.

Canadian Well Loggers Plan 2-Day Symposium

The Canadian Well Logging Society at Calgary, Alberta, will hold its two-day symposium November 14 and 15. Daytime sessions will cover the presentation and discussion of approximately 16 new papers on the use and interpretation of electrical, radioactivity and other well logs and related formation evaluation methods.

A number of American and Canadian oil companies have offered papers for this event as well as several of the research departments associated with major oil companies and service companies.

Three Societies to Boost Boy Scouts' Geology Month

October has been designated as Geology Month by the Boy Scouts of America, and a special plan has been devised by the oil industry and two professional geological societies to cooperate on a variety of projects and programs.

Announcement of the plan was made by the American Petroleum Institute, on behalf of the American Geological Institute, the American Association of Petroleum Geologists, and the Boy Scouts Organization.

The API noted that Oil Progress Week also takes place in October, so that Boy Scout Geology Month becomes a natural tie-in for oil men and others participating in the industry's annual observance. Oil Progress Week is scheduled for October 13-19, and is in the form of a report to the nation by the people of oil.

A comprehensive kit of materials has been prepared by the three associations for the Boy Scouts and their leaders. The kit includes an illustrated booklet explaining the rudiments of geology and listing projects that Scouts may undertake during the month and several inserts.

Clarence E. Brehm Named 1957 Oil Men President

Clarence E. Brehm was elected president of the Independent Oil Producers and Land Owners Association, Tri-State, Inc., at a joint meeting with the IPAA. Officers elected for the coming year included Victor R. Gallagher, first vice president; George Ellison, third vice president; John R. Lavens, Jr., secretary.

Also Elmer L. Hoehn, executive secretary; Fletcher Farrar, second vice president and Fred C. Newman, treasurer.

32nd Fall Meeting Set By Petroleum Engineers

A report on Humble's high-speed low-torque drilling device, results of advanced studies of oil recovery by underground burning, and field and laboratory reports on the miscible displacement process are among the 75 technical papers to be presented at the 32nd annual fall meeting of the Society of Petroleum Engineers of AIME.

The meeting will be held at the Statler Hilton, Baker and Adolphus hotels in Dallas, October 6-9. Three concurrent technical sessions will be held each day, one in each of the hotels. An attendance of over 3000 is expected.

California Producers Elect Garrison Committee Head

The Conservation Committee of California Oil Producers announced that it had elected Robert H. Garrison, of Hellman Estate, as its chairman for the ensuing 12 months. Garrison has served on the Conservation Committee for approximately 25 years. At the present time he is chairman of District No. 17, representing operators in the Seal Beach and Belmont Off-Shore fields.

Other officers elected were: First vice chairman, D. G. Kingman, representing District No. 1 (Antelope Hills, Belridge North, Lost Hills, Pyramid Hills etc.); second vice chairman, R. J. Stephens, representing District No. 24 (Sansinena, Montebello, Whittier, Bandini etc.); and secretary, R. B. Hodgson, representing District No. 22 (Inglewood, Beverly Hills, Los Angeles etc.)

Paul E. Terry, representative from District No. 12 (Santa Maria Valley), was

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elected chairman of the Administrative committee. Other members elected to this committee are Milan G. Arthur, T. W. Bell, O. A. Graybeal and R. G. Rogers.

B. P. Bayliss, representative from District No. 16 (Santa Clara Valley district), was elected chairman of the Engineering board. Other members elected to the Engineering board were A. J. Horn, Joseph Jensen, D. I. Johnstone, W. W. Kessler, S. A. Patterson, J. O. Richardson, L. R. Rogers, M. Silbergh and E. E. Nichols.

Dallas Petroleum Engineers To Host October Meeting

With 77 technical papers and a probable attendance of over 3000, the Society of Petroleum Engineers will hold its annual fall meeting in Dallas, October 6-9.

Papers on the program will cover such subjects as turbodrilling, percussion drilling, field tests of solvent flooding, new well completion techniques, as well as a number of laboratory studies.

Three concurrent technical sessions will be held daily, with one each in the Adolphus, Baker and Statler Hilton hotels.

This will be the first meeting of the Society of Petroleum Engineers since its name has been changed from Petroleum Branch, AIME. It will be the 32nd annual meeting, however, of the professional society for petroleum engineers.

The Dallas Local section of AIME will be host for the meeing. H. F. Beardmore, Warren Petroleum Co., Houston, will serve as honorary chairman, with Raoul J. Bethancourt of Sun Oil Co., Dallas, as general chairman.

Washington Attorney Joins Staff of IPA

William I. Powell, Washington attorney, joined the staff of the Independent Petroleum Association of America in Washington recently.

William I. Powell

Formerly associated with the American Mining Congress in Washington for eight years, Powell is thoroughly familiar with tax and legislative problems similar in nature and scope to those of the petroleum industry.

In the West Virginia legislature he was a member of the Judiciary, Insurance, Institutions, Forestry and Game and Fish committees.

Laughlin Is Picked RMOGA Vice President

A. F. Barrett, president, announced the selection of Robert B. Laughlin, as executive vice president of the Rocky Mountain Oil and Gas Association to replace F. E. Woodring who resigned earlier this year. Laughlin is a member of the Law department of Pan American Petroleum Corporation.

In addition to his service within the RMOGA as chairman of the Legislative committee for some six years, Laughlin has served as president of the Casper, Wyo., Rotary Club; president of the Natrona County Bar Association; secretary-treasurer of the Wyoming State Bar; a member of the American Bar Association; and a member of the board of directors of the Casper Chamber of Commerce.

Exploration Geophysicists Pick Clifford as Head

O. C. Clifford, Jr., chief geophysicist of The Atlantic Refining Co., has been elected president of the Society of Exploration Geophysicists succeeding Roy F. Bennett. Ben F. Rummerfield, executive vice president of Century Geophysical Corp. is to be the new vice president.

Other officers will be Howard E. Itten, president of Empire Geophysical, Inc., secretary-treasurer, and Dr. L. Y. Faust, of Amerada Petroleum Corp., editor. Terms of office will begin November 11, during the society's 27th annual meeting in Dallas.

Herbert Hoover, III Is AIME Junior Member

Herbert Hoover, III, son of the former Under Secretary of State and grandson of the former president of the U. S., has been elected a junior member of the Society of Petroleum Engineers of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

His father and grandfather are members of AIME, the former president of the U. S. being the senior past president of the Institute. The uncle, Allan Hoover, of Greenwich, Conn., also is an AIME member.

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New Books, Maps and Movies

SASKATCHEWAN CROWN ROYALTY TABLES WITH RESPECT TO CRUDE PETROLEUM, Foothill Printers Limited. 822—11th Avenue West, Calgary, Alberta, $5.

This handy booklet is designed particularly for production accountants, evaluation and petroleum engineers, governmental agencies etc. This time-saving device shows the Crown royalty payable on monthly production in barrels and on a percentage.

The tables cover a range of production from 500 barrels to 5000 barrels per month, in one barrel increments. Computation was made from the schedule contained in the Saskatchewan O. C. 603157, and is to the nearest hundredth of a barrel.

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1957 DIGEST (VOLUME 24), Tulsa Geological Society, Publications Business Manager, P. O. Box 263, Tulsa, $2.25, postpaid.

Subject matter in this year's publication ranges geographically from Bolivia to Wyoming and several other topics. In order to shorten required reading time the papers have been reduced to abstract form, in which cases editor's notations present data wherein the reader may quickly locate the subject paper published in its entirety.

In addition, several interesting papers relating to southern, northeastern and northwestern Oklahoma are presented.

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OIL AND GAS RECORD, The Record Publishing Company, P. O. Box 5770, Dallas 22.

This 1957 sixth annual edition is the largest and most complete of the series. The book has been designed for efficiency and ease of handling.

First, it is divided by states—Arkansas, Louisiana, Mississippi and Texas, plus the Permian Basin part of New Mexico. Second, each state is divided between producers and operators in one section and servicers and suppliers in the other; producers and operators are alphabetically on a state-wide basis, the servicers and suppliers are alphabetically by service or product by towns.

Third, each state has a cross index of the persons or firms in the 23 most important service or product classifications, this being arranged alphabetically on a state-wide basis.

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THREE BROTHERS, California Texas Oil Company, Public Relations Department, 380 Madison Avenue, New York 17.

This new sound and color film portrays domestic and cultural life in Sumatra and Java and the impact of the oil and other modern industries thereon.

The motion picture takes 30 minutes and is particularly recommended for non-technical audiences. The film has been produced in 16-mm size in English, Indonesian, French, Dutch and German languages.

•

ARCHER, BAYLOR AND CLAY COUNTIES, Rinehart Oil News Company, Box 1208, Dallas,

The 250-page volume, covering the development history of approximately 300 fields in the three-county summary, is the first in a series of five North Texas area reference books to be published during 1957.

When completed, the set will include maps, electrical logs, completeion histories and production statistics on some 1500 individual oil and gas fields located in Texas Railroad Commission District No. 9.

•

A SYMPOSIUM OF OIL & GAS FIELDS OF SOUTHEASTERN NEW MEXICO, 1956, Roswell Geological Society, P. O. Box 6732, Roswell, N. M.

The oil and gas pool information herein has been compiled and presented by some 25 company representatives and about 12 consultants. Structure contours or data sheets or both are shown for pay zones. The Society has followed the field nomenclature of the New Mexico Oil Conservation Commission and the New Mexico Engineering Committee in order to provide for unity and continuity.

Ownerships have been indicated on the maps where the information was immediately available. Pool outlines are shown

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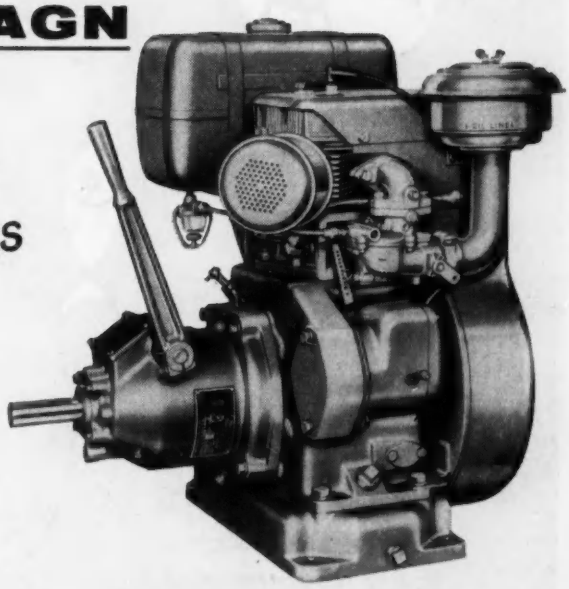

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as established by the Commission, and changes and extensions may be made at any time the information dictates the necessity.

•

MISSISSIPPIAN REPORTS, Saskatchewan Geological Society, Box 234, Regina, Saskatchewan, $25.

The Mississippian Names and Correlations Committee has just completed a report and a set of cross sections which are now available to the public. The report deals with the Mississippian stratigraphic sequence of the Northeastern Williston Basin and outlines a new system of Mississippian nomenclature. The new system of nomenclature has already been accepted by the Saskatchewan Department of Mineral Resources and by member companies of the Saskatchewan Geological Society.

The four sections comprise 34 key wells that embrace the most complete Mississippian sections in a 50,000 square mile area of southeast Saskatchewan, Manitoba and the northern U. S. and traverse the Poplar, Beaverlodge-Tioga, and Midale, Steelman, Alida, Whitewater and Roselea fields.

•

ANALYSES OF BRINES FROM OIL-PRODUCTIVE FORMATIONS IN OKLAHOMA, Reports of Investigations 5326, Publications-Distribution Section, Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Penn.

To assist conservation of petroleum resources, the Department of the Interior made public a Bureau of Mines technical report giving detailed analyses of water obtained from nearly 1000 oil wells in Oklahoma.

Bureau researchers, who conducted the extensive study in cooperation with the State of Oklahoma, point out that the results are of special interest to operators contemplating water-injection methods to prolong the productivity of wells. The analyses and electrical resistivity measurements also are useful in identifying intrusive waters in producing oil wells and in electric logging. The study was limited to areas not now employing water flooding.

•

PETROLEUM REVIEW, DAWSON AND MARTIN COUNTIES, TEXAS, Phifer Petroleum Publications, P. O. Box 20024, Houston 25, $10.

The new book is No. 9 in a series that has covered 11 counties of the Permian Basin of West Texas and New Mexico. The series will eventually cover all the oil and gas producing counties of the region.

The review was compiled from the records and hearing files of the Railroad Commission of Texas in Austin. It is profusely illustrated with structure maps presented as exhibits before the Commission as well as electric logs of discovery wells, a two-color county map and geological chart for West Texas. It also outlines the discovery, development and production in each county separately although the two are included in the same book.

•

GEOLOGY OF EVANGELINE AND ST. LANDRY PARISHES, Geological Bulletin No. 31, Louisiana Geological Survey, P. O. Box 8847, University Station, Baton Rouge 3, La., $1.

The area covered by the bulletin is in the trend of prolific oil and gas production from sediments of Tertiary Age. The bulletin contains the results of a comprehensive study of the surface and subsurface geology of the two parishes and a section on the economic geology of the area, which includes petroleum geology, surface water, ground water, sand and gravel deposits and clay deposits.

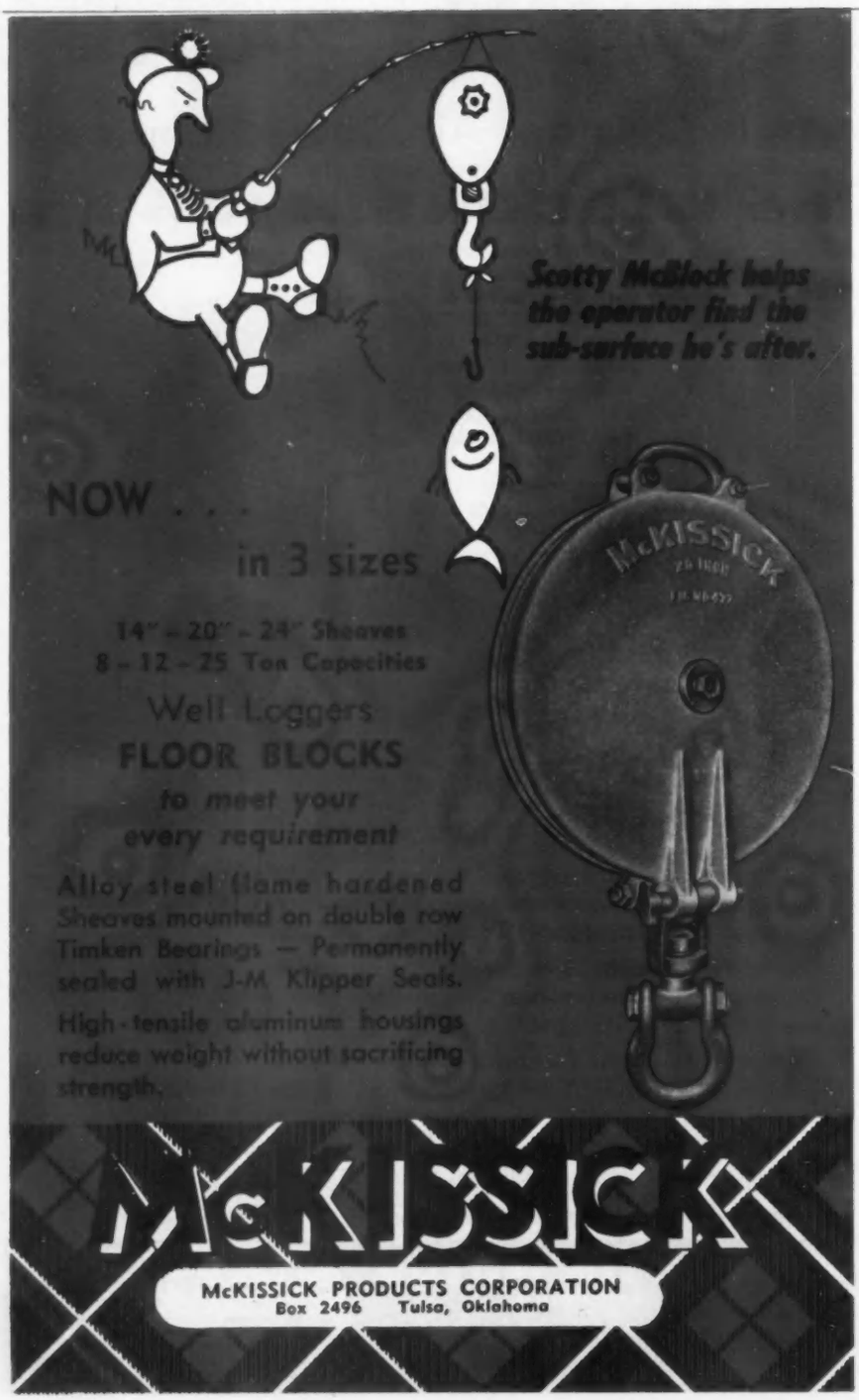
Of particular interest to the oil fraternity will be the petroleum geology section which has a large amount of information on the producing sands including structure maps contoured on the top of the first Marginulina sand, base of Moodys Branch marl, top of Basal Cook Mountain marl and top of the Wilcox. Contour maps on the producing horizons, or a marker bed, are presented for each field. A composite electric log of the two parishes is presented which shows the stratigraphic sequence and typical development of producing zones.

•

GLOSSARY OF GEOLOGY AND RELATED SCIENCES, American Geological Institute, 2101 Constitution Avenue, Washington, D. C.

This glossary was compiled under the auspices of the American Geological Institute by a task force of nearly 100 specialists from more than 25 areas of geology and related sciences directed by J. V. Howell, consulting petroleum geologist, Tulsa.

The glossary contains approximately 14,000 terms—far more than any other glossary or dictionary covering the field. It contains not only many terms relating to theoretical geology and geophysics but also many commonly used in applied petroleum, mining and engineering geology. In addition there are many meteorological terms.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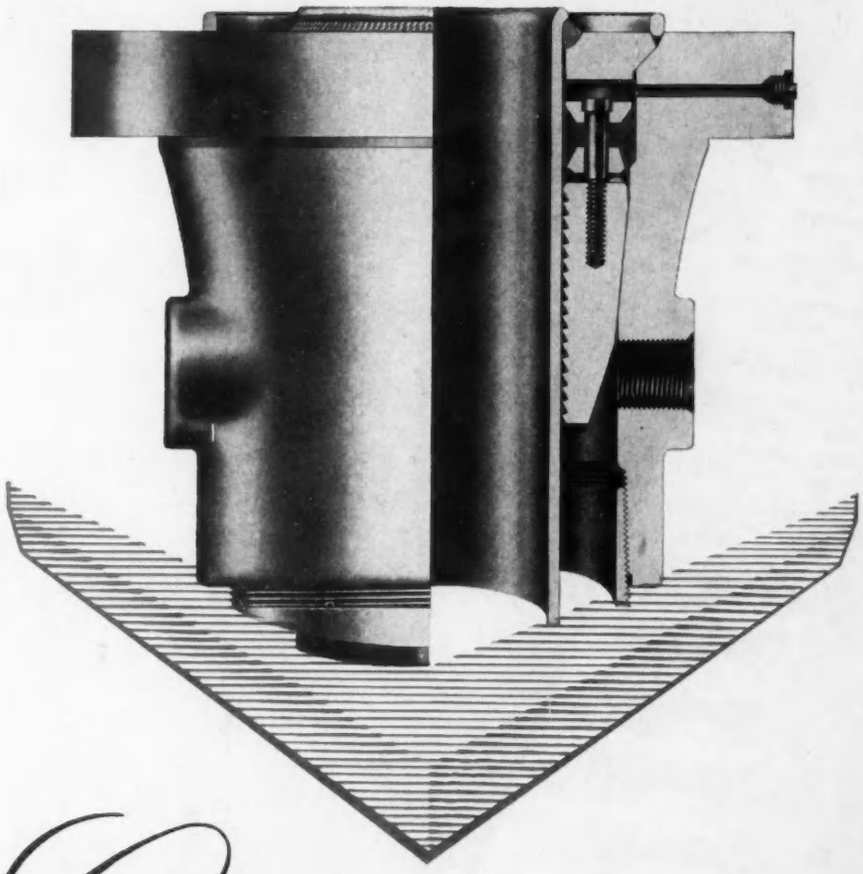

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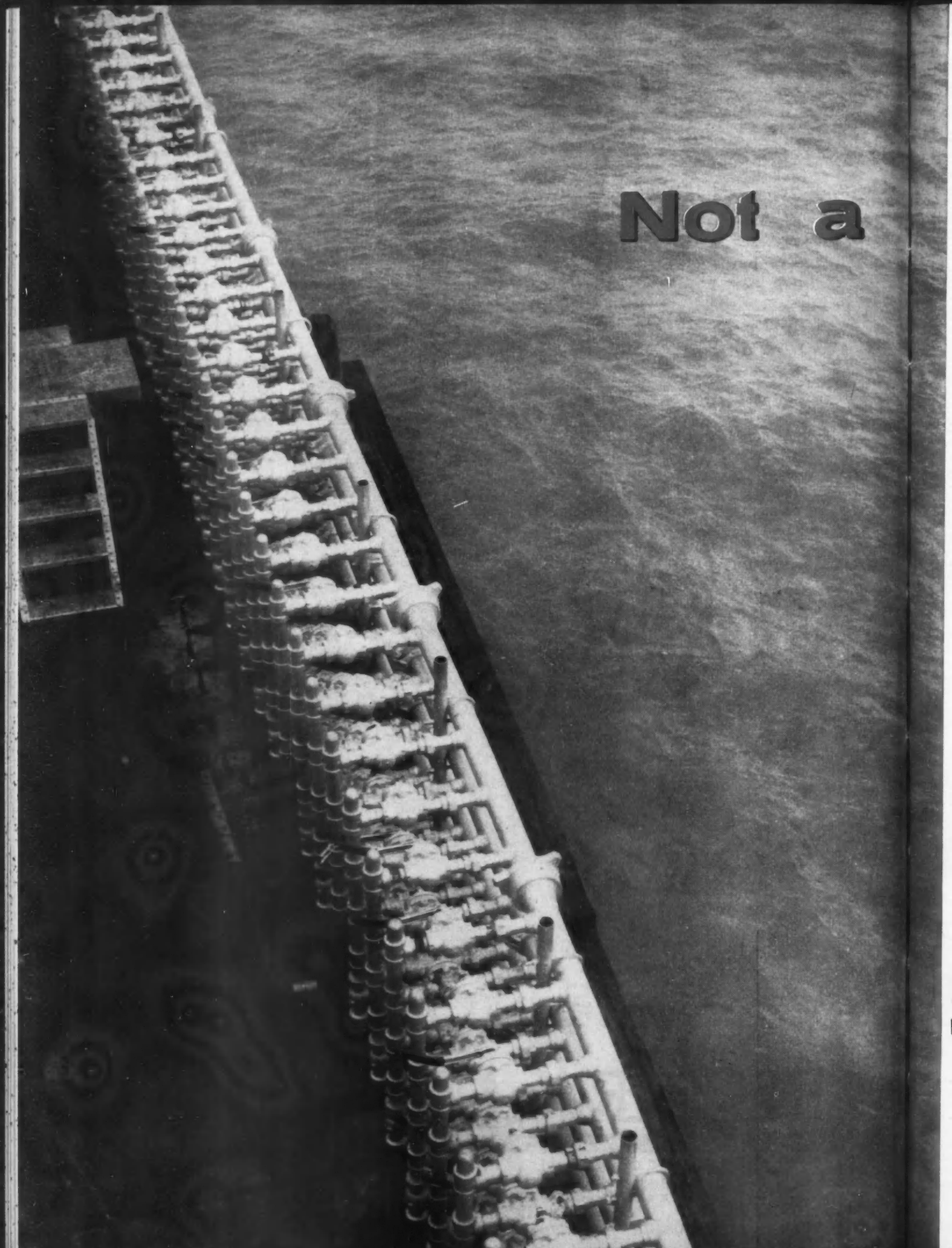
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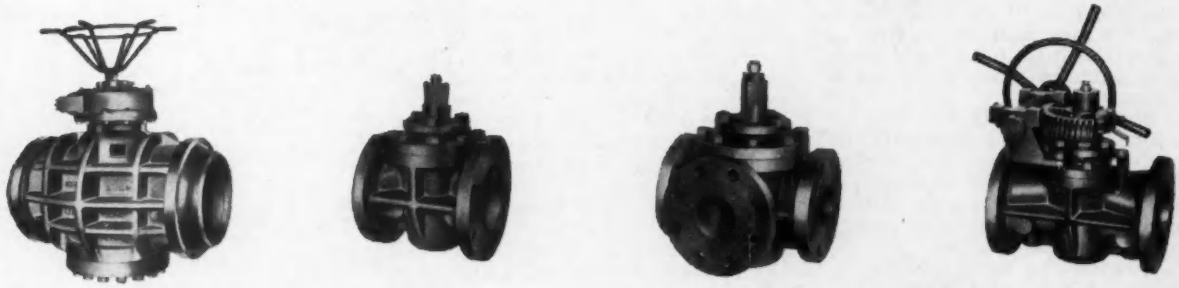

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What's Happening among SERVICE and SUPPLY MEN

Claude L. Griffin

W. R. Wheeler, Jr.

American Iron & Machine Works Company announced the following promotions. **Claude L. Griffin** has been named vice president and assistant to the president. Griffin started with American Iron in 1947, attached to the Engineering department on special tool joint design projects. In 1949 he was appointed sales manager and has held this position until his recent promotion. **Varney S. Harlin** has been made vice president in charge of engineering and manufacturing. Harlin began with American Iron in 1934, as a machinist in the machine shop. In 1937 he was transferred to the Engineering department and became chief engineer in 1940. In 1954 he was made manager of engineering and manufacturing, this title he held until his recent promotion. **W. R. Wheeler, Jr.**, has been named sales manager. Wheeler began with American Iron in 1935. He has been in the Sales department in various positions since that time, having been in every active drilling area. Wheeler was made assistant sales manager in 1953. Prior to becoming assistant sales manager, he was special representative in Tulsa.

Varney S. Harlin

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Francis H. Boland, Jr., was elected a director of **ACF Industries, Incorporated.** Boland is vice president and director of The Adams Express Company and vice president of its subsidiary, American International Corporation. He also is a director of the Joy Manufacturing Company of Pittsburgh and a member of its executive committee.

•

K. D. Malick and **L. H. Spargo** have been appointed manager of petroleum and chemical sales, and of general industrial sales, respectively, in the Houston district office of **Allis-Chalmers Industries group.** Malick has been associated with Allis-Chalmers since 1939 as an electrical engineer. He has been a sales representative in the Houston district since 1947. Spargo joined Allis-Chalmers in 1942. He has been a sales representative in the Houston district for about ten years.

•

Fairbanks, Morse & Co. elected **Robert H. Morse, Jr.,** president and chief executive officer. In addition to Morse, 14 officers were elected, including four who will occupy new positions. In new posts will be: **Gordon R. Anderson,** vice president, engineering; **F. M. Mason, Jr.,** vice president, government business; **Robert Dana Brown,** secretary and assistant treasurer; **R. E. Whiteley,** assistant secretary.
Re-elected were **Robert B. Craig,** vice president; **John A. Cuneo,** vice president, foreign operations; **L. R. Gaiennie,** vice president, personnel; **Donald L. Harwood,** vice president, purchases; **Orren S. Leslie,** vice president, manufacturing; **G. J. Malone,** vice president, comptroller; **R. H. Morse III,** vice president, budgets & planning; **V. H. Peterson,** vice president, sales; **L. W. Stolte,** vice president, treasurer; **E. T. Sandeen,** assistant secretary.

•

Charles P. Siess, Jr., formerly assistant division manager at Anaco, Venezuela, for South American Petrolite Corporation, has been appointed assistant to **James E. Stockton, Jr.**, general sales manager for the **Tretolite Company,** division of Petrolite Corporation, and now is located in the St. Louis home office. Siess served more than four years with the company as field engineer specializing in corrosion problems in the Arkansas, north Louisiana, Mississippi and East Texas area. His duties in South America included working both in the production and the refining phase of the industry. Besides covering part of the Maracaibo region, Siess also covered the Trinidad area.

Charles P. Siess, Jr.

•

Continental - Emsco Company announced the appointment of seven employes to the position of division merchandise manager. **H. C. Fox** will serve as division merchandise manager for Continental - Emsco's Arkansas, North Louisiana, Mississippi and East Texas division. **G. L. Parks** will fill this position for the Rocky Mountain division. **R. E. Schiebel** will be division merchandise manager for the South Texas and South Louisiana division. **Harry Hobbs, Jr.** will cover Continental-Emsco's Kansas, Oklahoma and North Texas divi-

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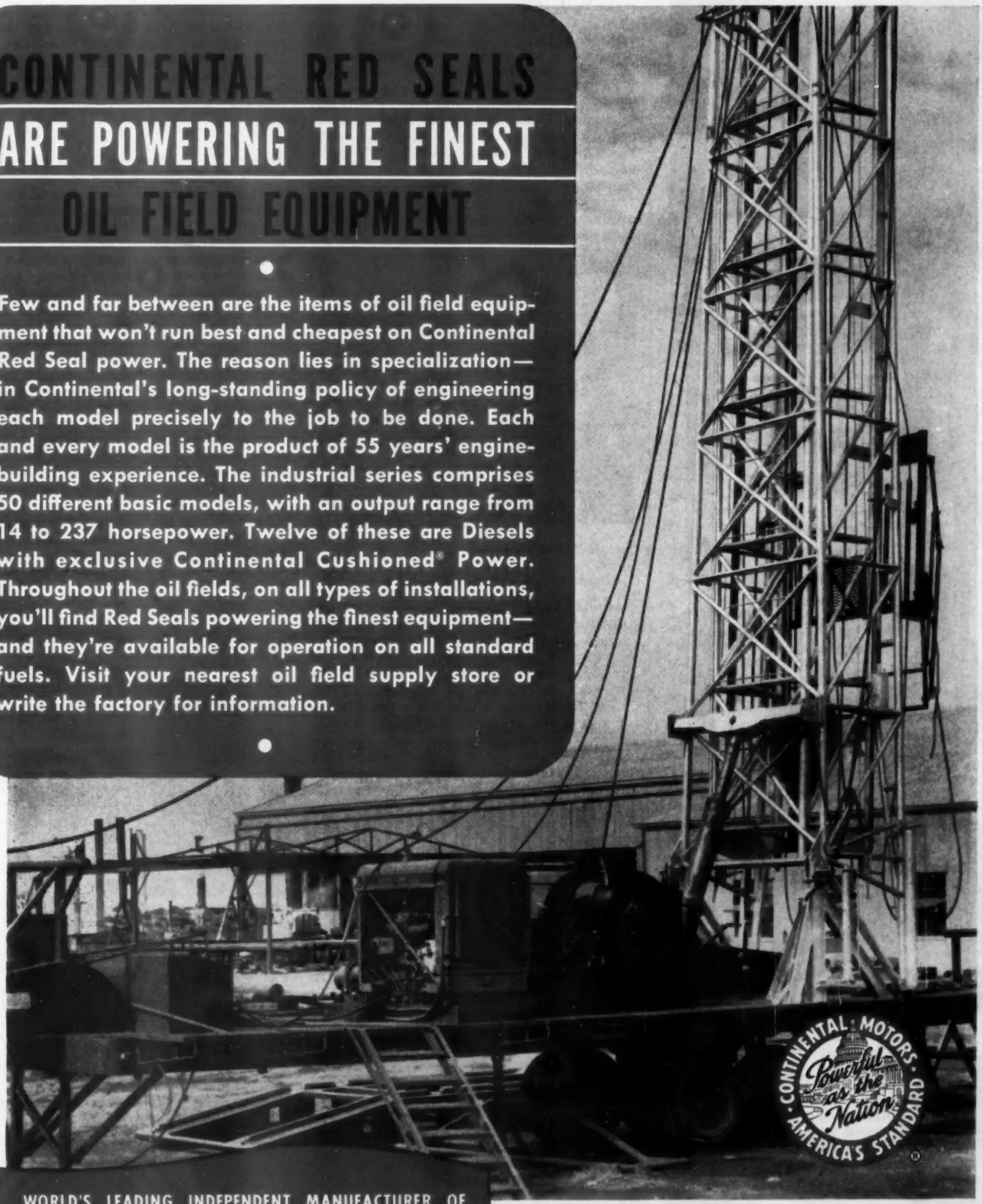

WORLD'S LEADING INDEPENDENT MANUFACTURER OF INTERNAL COMBUSTION ENGINES, CONTINENTAL MOTORS OPERATES PLANTS IN ATLANTA, DALLAS, DETROIT, MILWAUKEE, MUSKEGON, AND TOLEDO, AND IN ST. THOMAS, ONT., PRODUCING AIR-COOLED AND LIQUID-COOLED ENGINES FOR USE ON LAND, AT SEA AND IN THE AIR.

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MERRICK PHELPS is the man at CApitol 7-0521, Houston

WEB WILSON
OIL TOOLS, INC.
LOS ANGELES DALLAS
NEW YORK

sion. **P. J. Allen** will head division merchandise activities for Continental-Emsco Company Limited. **Ralph Dodworth** will head the California division merchandise functions. **Wendell True** will cover the West Texas and New Mexico division as division merchandise manager. Continental-Emsco's classification of division merchandise manager is new. In this position, these men will work closely with all stores and offices throughout their divisions. Functions of the division merchandise manager include: recommendations of new products, coordination of the introduction of new products and complete working control over stocks of new equipment and replacement parts.

•

Joseph H. Schlobohm

Joseph H. Schlobohm has been appointed regional sales manager of the European and Middle East areas for the **Joy Manufacturing Company** and its Oil Field division, Baash-Ross Co. He was formerly located in Cairo, Egypt, but will now take up residence in Paris.

•

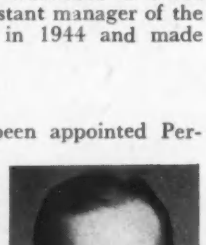
National Tube Division's Sales department announced two major appointments. **William J. McKee,** who is presently general manager of sales, became assistant vice president—sales and **Robert E. Williams,** director, distribution and availability, U. S. Steel, was appointed general manager of sales, succeeding McKee. McKee began his business career with National Tube Company in 1912 in McKeesport. Williams started his steel career as a draftsman in the General Sales department of the former Columbia Steel Company in San Francisco in 1935. In 1956 he was appointed director of distribution and availability, U. S. Steel, Pittsburgh.

•

Milford H. Luttrell has been named general sales manager of the **Walworth Company.** Luttrell joined Walworth in 1933. He was appointed assistant manager of the Southeastern division in 1944 and made manager in 1949.

•

Harold Whitely has been appointed Permian Basin area sales manager for **Baash-Ross Tool Company,** division of Joy Manufacturing Company. He has been with the company since 1953 as a field representative in the Odessa area, and will continue to make his headquarters there. Whitely has been engaged in oil well production, drilling and supply work since 1933.



Harold Whitely

•

Paul A. Manor, chief engineer of **Rockwell Manufacturing Company's** Barberton, Ohio, Valve division, has been promoted to chief engineer, Central Valve Research and Development department at Pittsburgh. Manor joined Rockwell in his most recent capacity in 1954, after ten years as chief project engineer of Surface Combustion Corporation at Toledo, Ohio. Earlier, he spent seven years in engineering work at the Ohio company's Toledo plant.

•

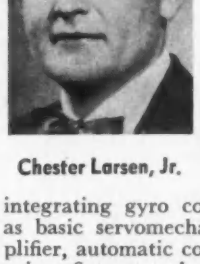
Walter E. Spieth, previously manufacturing vice president of Reo Motors, Inc., has been named master mechanic of **Coote & Jorgensen, Ltd.,** Australian subsidiary of Borg-Warner Corp. Spieth also has served as general superintendent of the Transmission division of Clark Equipment Corp. and as master mechanic of the Hillsdale Steel Products division of Dana Corp.

•

Fluid Packed Pump Company announced the following promotions. **D. H. Vandenberg** has been appointed general sales manager in complete charge of the company's sales and service activities throughout the world. **Glen Peters** has been appointed manager of distributor sales. Besides coordinating distributor sales, he is in full charge of Fluid Packed Pump's sales and service activities in the Gulf Coast, Southwest, Midwest, Eastern, Northwest and Canadian divisions. **Harold H. Palmour** has been made manager of the Southwest division, succeeding Peters in this position.

•

George Quist, president of **Mandrel Industries, Inc.,** of Houston, announced the appointment of **Chester Larsen, Jr.,** as his assistant. Prior to coming to Mandrel Larsen served as a research engineer for Northrop Aircraft Co. and for two years was head of fire control instrumentation for A-C Spark Plug Division, General Motors. He has been responsible for the design and development of inertial guidance computer components and integrating gyro control circuitry as well as basic servomechanism, operational amplifier, automatic counting, precision measuring, fire control and computer circuits.



Chester Larsen, Jr.

•

William R. Hunsicker was appointed head of LORAC research and **Edward D. Jones** as technical writer in the Research department have been announced by **Seismograph Service Corp.** Hunsicker is rejoining SSC after two years with the Douglas Aircraft Co. in Tulsa as research engineer. Jones is a former Douglas employe, having been a writer in the Engineering Technical Publications department. Hunsicker joined SSC in 1951 as a laboratory technician in LORAC research. He was a research engineer in 1955 when he left SSC. Jones joined Douglas in 1952 as technical writer and was head of the electrical and electronics test writing group and engineering report writing group.

•

Perforating Guns Atlas Corporation has recently opened five new stations. **R. M. Haynie** with the company seven years, has been transferred from PGAC's Greggton,

Texas, station where he was district manager, to the same position at the company's new office at Shreveport, La. **Lee Buel,** field engineer, has been transferred from the station at Houma, La., and put in charge of the company's new station at Buras, La. He has been with PGAC over three years. **J. E. Crouch,** with PGAC seven years and formerly field engineer at the company's Lafayette, La., station, has been put in charge of the new station at Magnolia, Ark. **John S. Rhodes** has been transferred from the Odessa station and made district manager of PGAC's new station at Farmington, N. M.

W. E. McCarroll, salesman, has been transferred to the company's new station at Crane, Texas. He has been with the company six years and was formerly at the Odessa station. **Charles B. Melvin,** with PGAC over nine years and previously district sales representative at the Graham, Texas office, has been promoted to district manager in charge of the Panhandle district, with headquarters at the company's station at Pampa, Texas. **James H. (Buddy) Rodgers,** with the company nine years and formerly a district sales representative at the Victoria, Texas, station, has been promoted to district manager of PGAC's new station at Laurel, Miss. The company's offices at Tulsa have been moved to 705 Mid-Continent Bldg. **James T. Brockman** is the salesman in charge of the Tulsa office.

•

Robert C. McNeill was appointed chief engineer of the **Martin-Decker Corp.,** Long Beach, Calif. In his new position McNeill will assume responsibility for new product development and engineering research. Prior to joining Martin-Decker, McNeill spent several years with the Shell Oil Company in the Pacific Coast area specializing in both upland and offshore oil field equipment problems and research.

•

Alex F. Fino

Alex F. Fino has been appointed chief engineer of the **Hammond Iron Works.** He has been associated with the Hammond Iron Works since 1940. Fino has had the principal responsibility for the design and development of various Hammond patented products including Tubeseal Float-Roof, Dialift, Diafloat and other oil conservation devices.

•

J. H. Adkison, formerly manager at Ardmore, Okla., for **Dowell Incorporated,** has been transferred to the Tulsa headquarters as assistant to **D. E. Ramsey,** manager of operations. **I. R. Bielek** has been transferred from St. Louis to be district operations manager at Cleveland, Ohio.

•

William S. Thielman was appointed **U. S. Steel Corporation's** Oil Well Supply division assistant to area manager, machinery sales at Casper. Thielman was employed by Oilwell in 1956 as assistant district engineer, machinery and equipment sales. Prior to his employment with the division Thielman had four years oil field experience.

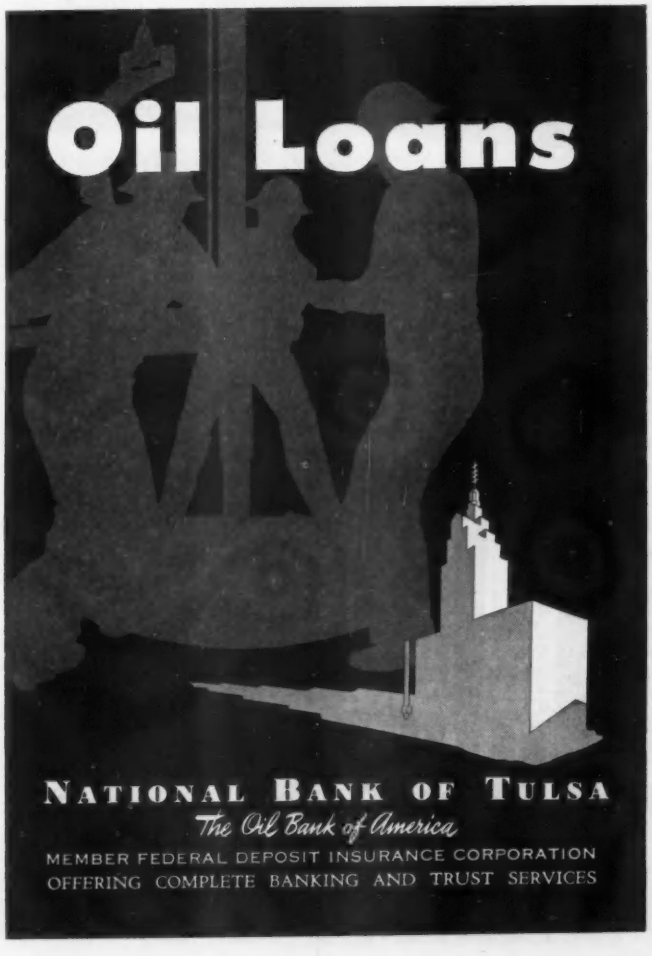
A. A. Barr

C. E. R. Millidge

C. E. R. Millidge and **A. A. Barr** have been appointed to the board of directors of **C. C. Wakefield & Co., Ltd.,** in conjunction with their present offices of manager, Castrol division and group publicity manager, respectively. Millidge joined Wakefield in 1918. In 1926 he was appointed Castrol representative for the Bucks and Northants area. Later he became assistant manager of the Motor department, and, two years later, manager. In 1952 he was appointed manager of the Castrol division. Barr joined Wakefield 29 years ago as a junior in the Publicity department and in 1938 became assistant publicity manager under J. A. V. Watson. Later he became manager of his department, and in 1955 group publicity manager.

•

Frank Crane, chief engineer for the **Martin-Decker Corp.,** recently announced his decision to accept an assignment at the Massachusetts Institute of Technology in Cambridge, Mass. He will assist in graduate school instruction and plans to continue studying for his Ph.D. in petroleum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engineering. Crane's association with the firm has resulted in many technical advances in the company's precision drilling control instruments and in its line of industrial weighing instruments.

•

John Clote

John Clote, formerly field engineer for the **Tretolite Company,** division of Petrolite Corporation, at McPherson, Kansas, has been named assistant advertising manager of Petrolite, assigned to the St. Louis headquarters. Clote joined Tretolite in 1952 at McPherson. He served as district editor for the Oil and Gas Journal at Tulsa and later at Houston.

•

International Harvester Company has announced that the company has elected **Brooks McCormick** an executive vice president, succeeding **Christian E. Jarchow** who will retire after 43 years. Jarchow will continue as a member of the company's board of directors. McCormick joined International Harvester in 1940 at its McCormick works. In 1951, he was sent overseas as joint managing director of International Harvester Company of Great Britain, Ltd., and in 1952 he was elected managing director of the British subsidiary company. He served in that capacity until 1954 when he returned to the U. S. to become director of manufacturing of the parent company.

R. F. Mallina, inventor and authority on the solderless wrap connection, joined the **Gardner-Denver Company** as a research consultant. Mallina comes to Gardner-Denver after retiring from Bell Telephone Laboratories, Inc., where he served for 28 years, most recently as head of the mechanical development group of the Switching Apparatus Development department. In his new position, he will work with the company's Keller Tool division that has plants at Grand Haven and Reed City, Mich. Among the 80 patents issued in Mallina's name is one on the solderless wrapped connection. In 1953 he designed a machine controlled by a punched tape that connected the terminals of electrical components. This became known as the M-4 wiring machine. With Gardner-Denver, Mallina will concentrate his efforts on the commercial application of this type of connection, both with handheld tools and other mechanized methods of electronic assembly.

R. F. Mallina

•

Baash-Ross Tool Company has announced the appointment of **R. C. (Bob) Brenner** as Gulf Coast area sales manager, with headquarters in Houston. Brenner has previously represented Baash-Ross in the Shreveport, Rocky Mountain, Dallas and Houston areas. **Fred Waller** has been transferred from New Orleans to Houston to represent Baash-Ross in the East Texas area. Waller joined the firm in Houston in 1945.

•

Tracerlab, Inc., announced that **W. Harrison Faulkner, Jr.,** had been promoted to the position of general manager engineering and development. Faulkner, formerly chief engineer of the Industrial division has been with Tracerlab since 1948 and has served as business manager of its Western division.

•

D. D. Mize, general manager of **Electro-Technical Labs. division of Mandrel Industries, Inc.,** and vice president of Mandrel, announced the appointment of **Joe J. Du Rapau** as his assistant. Du Rapau has been affiliated with the seismograph manufacturing business for over nine years and he will assist Mize in the sale of Electro-Tech products. For more than six years he was engaged in the design of exploration seismic equipment for Technical Instruments Company.

Joe J. Du Rapau

•

R. J. Keller has been named chief engineer of the **A. O. Smith Corporation's**

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•

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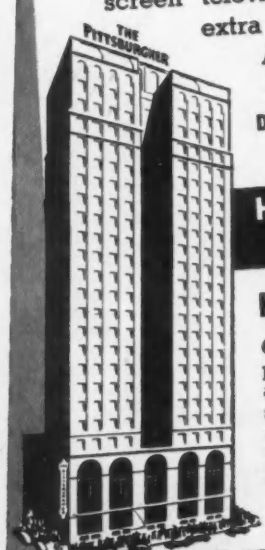

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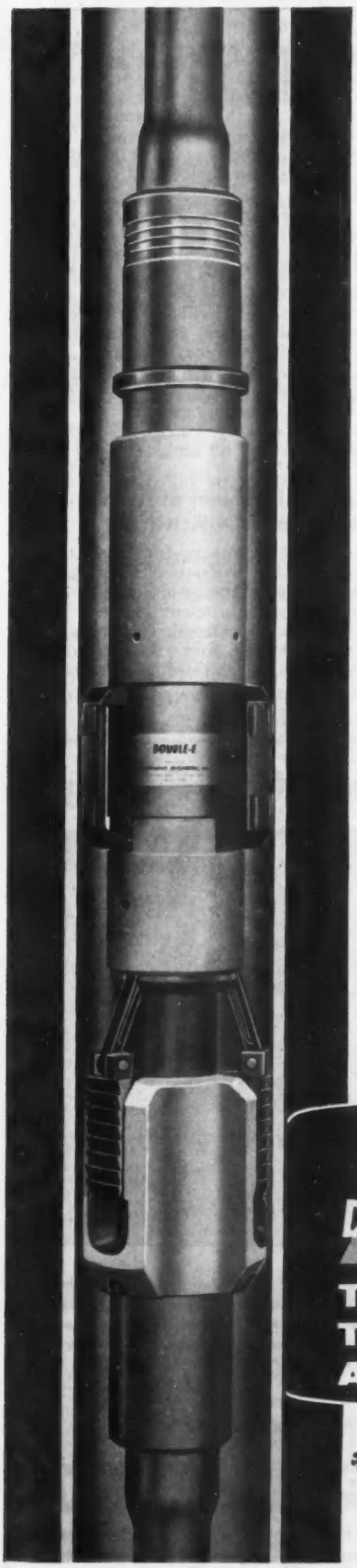


check these actual results of a Double-E Tension Tubing Anchor

BEFORE		AFTER
36 bbl oil per day	1957 Test	55 bbl oil per day
558 bbl water per day		630 bbl water per day
74% pump efficiency		85.5% pump efficiency
4 rod jobs in month		No rod jobs

Interestingly, this tension tubing anchor was run strictly to prevent rod jobs. Yet look what happened to pumping efficiency!

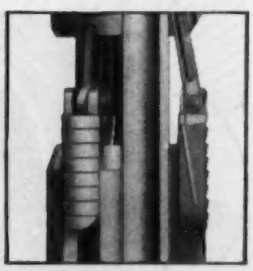
The Double-E Tension Tubing Anchor

HERE'S WHAT IT DOES: Efficiency in a pumping well increases tremendously when the tubing is correctly anchored in tension! Here's how:

1. You get more fluid lifted per stroke
2. Working life of tubing and rods is increased
3. Rod jobs are greatly reduced
4. Collar leaks and wear are eliminated

HOW TO USE IT: Install the tension tubing anchor above or below the pump — or at any desired depth. Set the tool by rotating the tubing a partial turn to the left. Then exert an upward pull on tubing string. The tubing is now anchored in tension.

HERE'S HOW IT WORKS: With its powerful grip on casing, tubing is now held motionless. This eliminates wear between tubing and casing. Also, with strain of load-reversal off the tubing joints, costly collar leaks and damaged threads are prevented. You get much more fluid lifted per stroke and an increase in working life of entire tubing string.



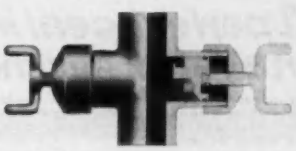
HOW TO RETRIEVE: Simply lower and rotate the tubing a partial turn to right and anchor is re-jayed. If re-jaying is impossible, merely exert a straight-up pull *in excess* of the Slip Failure Rating*. The Double-E Tension Tubing Anchor is designed so the slip-flanges shear upon excess pull. This releases the slips and the tubing string can be easily retrieved without loss of parts in the hole.

Write for full details today. No obligation.

DOUBLE-E TENSION TUBING ANCHOR

*Slip Failure Rating is either 20,000 lbs., 30,000 lbs. or 40,000 lbs. as you may specify.

When polish rod blowout preventers are needed, you can find none better than Double-E Blowout Preventers . . . at your supply store.



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Welding Products division. Formerly he was assistant to **J. J. Chyle**, Smith's welding research director. Keller will be in charge of engineering for the company's three welding products plants at Milwaukee, Elkhorn, Wis., and Leola, Penn. He has been with A. O. Smith since 1939.

•

Paul Jordan, plant engineer at the **Dodge Manufacturing Corporation** since 1943, has been appointed director of engineering. In his new position Jordan will direct all engineering and development work at Dodge. As plant engineer he has been responsible for the company's buildings and equipment. He is credited with designing the new mechanized foundry at Dodge and has been a key figure in an extensive plant expansion and improvement program which is nearing completion in Mishawaka, Ind.

Paul Jordan

•

Frank W. Murphy, Mfr. Inc., of Tulsa announced the appointment of **W. M. (Bill) Moore** as sales and service engineer for the West Texas and New Mexico area. Moore has spent the past three years in various Manufacturing departments of the Murphy Safety Switch organization.

Jones & Laughlin Appoints Container Sales Representative

Palmer Supplies Company, Times Star Building, Cincinnati 2, Ohio, has been appointed to represent the Container division of Jones & Laughlin Steel Corporation in the sale of steel drums and shipping pails.

The Container division of J&L has nine plants in nine different cities. They manufacture a full line of steel drums and shipping pails for packaging of oil, chemicals, food, drugs, soap, detergents, asphalt and specialty products.

Lone Star Steel Company Names Bethlehem Supply Distributor

Bethlehem Supply Company, a subsidiary of Bethlehem Steel, was named as a distributor of oil field casing and tubing manufactured by Lone Star Steel Company. According to E. B. Germany, president of Lone Star who made the announcement, the deal is a straight sales arrangement and covers only oil country goods.

Tracer Lab Symposium to Discuss Radioactivity in Oil Production

Tracerlab's 1957 oil symposium will deal with the subject of applications of radioactivity in petroleum production. It will be held in Houston at the Shamrock Hilton Hotel, November 6, 7 and 8. About 20 papers will cover specifically the subjects of research and instrumentation, field uses of radioactivity and logging.

The papers all contain original material and will be presented by representatives of leading exploration and production groups.

For complete details, write Symposium Committee, Technical division, Tracerlab, Inc., 1601 Trapelo Road, Waltham, Mass.

U. S. Government Receives 305 Jeeps on Contract

Three hundred and five Jeep vehicles were delivered during May by Willys Motors, Inc., to the U. S. government on two contracts from the General Service Administration totalling $651,005.89.

The 4-wheel drive vehicles went to virtually every state in the union and to several foreign countries for use by various agencies of the Department of Interior, Department of Agriculture and Department of State.

Foreign countries where some of the vehicles eventually will be in service include Belgian Congo, Southern Rhodesia, Kenya, India, Greece, Nigeria, Burma, Korea, Yugoslavia, Panama, Austria and Finland.

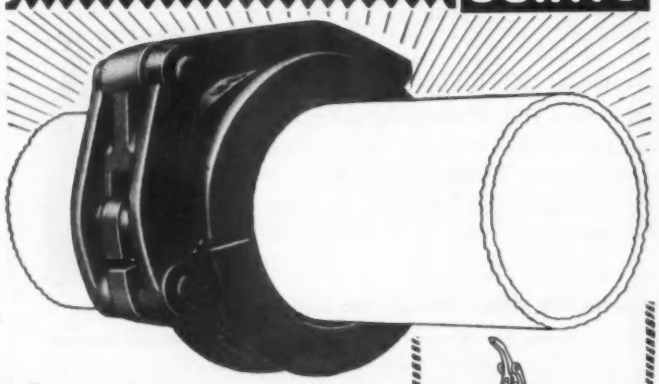
The 305 vehicles include 113 utility wagons, 78 pick-up trucks, 25 sedan delivery trucks and 89 civilian Jeeps.

Equipment Engineers of Dallas Absorbs Drovil Co. Activities

Equipment Engineers, Inc., Dallas manufacturers of oil production tools, have assumed the manufacture and sale of certain oil production equipment formerly manufactured by the Drovil Company, Lancaster, Texas—a firm which recently moved from Los Angeles.

The equipment covered by the agree-

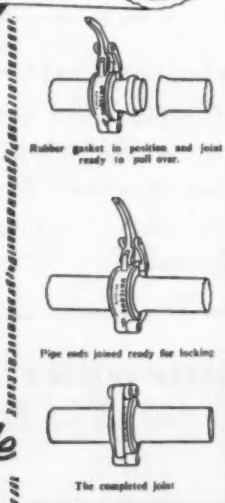
INSTANTANEOUS! JOINTS



A perfect seal in a matter of seconds

For temporary pipe lines 'Unicone' instantaneous joints are recommended. Comprising two parts only, they fasten with a "snap" ensuring a perfect seal in a matter of seconds.

For permanent or semi-permanent pipe lines 'Unisone' bolted type joints are usually employed and can be assembled far more quickly than any flexible joint giving positive anchorage.



'UNICONE' REGD
Flexible Joints for all Pipelines.
leakproof. safe. reliable

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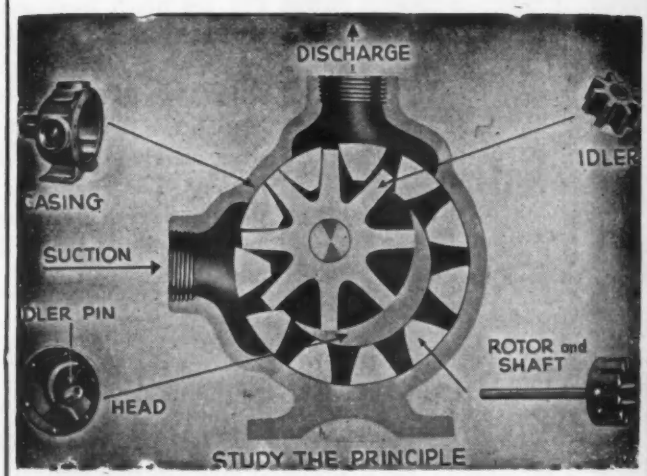
Viking Operating Principle



Above are illustrated the major parts of the Viking Pump—casing, head, rotor and idler, separately and assembled. Imagine the rotor and idler in motion operating in a counterclockwise direction. Follow the course of the liquid from point of suction to point of discharge. Reverse direction will operate equally well. We invite your inquiries.

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Mud Capacity
(at 20 psi operating pressure)

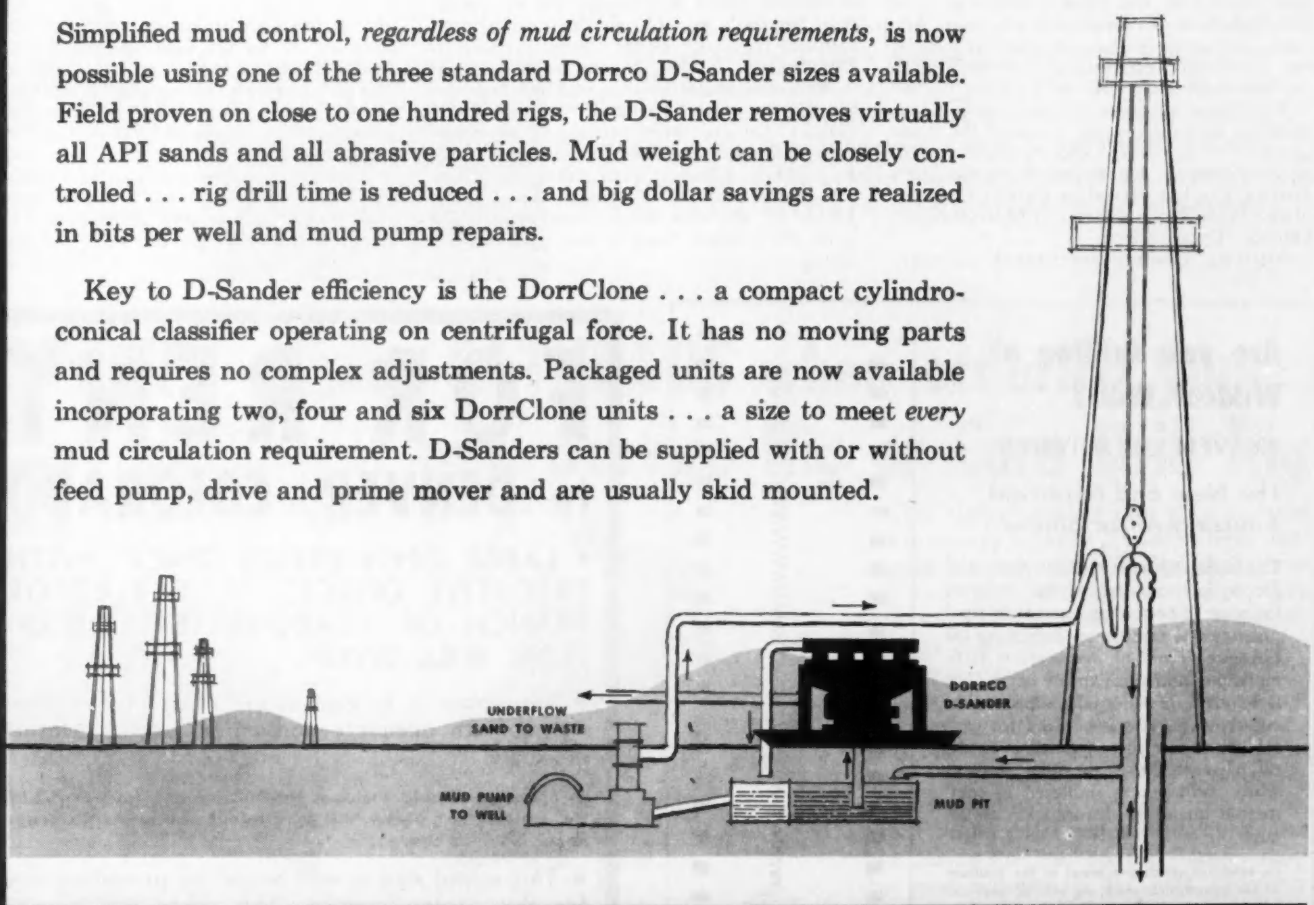
#2 D-Sander — 200-250 gpm

#4 D-Sander — 400-500 gpm

#6 D-Sander — 600-800 gpm

Simplified mud control, *regardless of mud circulation requirements*, is now possible using one of the three standard Dorrco D-Sander sizes available. Field proven on close to one hundred rigs, the D-Sander removes virtually all API sands and all abrasive particles. Mud weight can be closely controlled . . . rig drill time is reduced . . . and big dollar savings are realized in bits per well and mud pump repairs.

Key to D-Sander efficiency is the DorrClone . . . a compact cylindro-conical classifier operating on centrifugal force. It has no moving parts and requires no complex adjustments. Packaged units are now available incorporating two, four and six DorrClone units . . . a size to meet *every* mud circulation requirement. D-Sanders can be supplied with or without feed pump, drive and prime mover and are usually skid mounted.



For more information on the Dorrco D-Sander, contact our U. S. Sales Representative, Salt Water Control Inc., 1211 Fort Worth National Bank Building, Fort Worth 2, Texas.

D-Sander T.M. Reg. U.S. Pat. Off.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

ment includes lighter oil field production tools such as polish rod lubricators, stuffing boxes, tubing and casing swabs and sucker rod strippers. This equipment which was formerly manufactured by the Drovil Company will now be known as "Drovil Type" tools—a brand of Double-E merchandise.

John W. Coulter

R. L. Walker

Farmington to Be Included In New McCullough District

McCullough Tool Company has formed a new operating district, called Four Corners district in the Four Corners area of New Mexico, Colorado, Utah and Arizona. Included in the new district will be the previously established service branch at Farmington, N. M.

The Four Corners district, with headquarters at Farmington, is under the management of John W. Coulter, district manager. Prior to his transfer to the new district, Coulter served as district manager of the West Texas district at McCullough's Odessa, Texas, office.

Assisting Coulter are branch manager R. L. Walker who directs service operations at the Farmington branch and B. L. Martin, branch manager of a new service location just opened at Cortez, N. M. Sales representatives in the Four Corners district include O. L. Van Landingham and Clarence O. Wilson.

Floyd Moore Name Changes To Rocky Mountain Specialties

The firm name of Floyd Moore Sales and Service of Casper, Wyo., has been changed to Rocky Mountain Speciality Warehouse Co. The company is exclusive distributor for Grant Oil Tool Company and MacClatchie Manufacturing Company oil field products in the Rocky Mountain area. Wayne Connors is the manager.

New Iverson Supply Store Opens In Four-Corners Area

The Iverson Supply Company, Tulsa, Oklahoma, has announced the opening of a new Iverson Supply Store in Cortez, Colo. The new supply store will serve Colorado, New Mexico, Utah and Arizona.

The new store will offer a complete, around-the-clock service for the oil industry, and will be able to draw additional supplies from the Iverson Supply Store in Farmington, N. M., during rush periods.

An experienced Iverson staff will operate the Cortez store. The staff includes J. R. (Dick) Lynch, store manager, formerly field salesman for the Farmington store; J. E. (Ed) Chaney, field salesman, formerly store man at Sherman, Texas, and James R. Roberts, store man, previously with the Iverson Supply Store in Odessa, Texas.

TI Flies 'SeisMAC' to Paris To Help Europe's Oil Search

To make more effective the intensive search for petroeum in Europe, a "seisMAC," the "electronic brain with a degree in geophysics," has been flown to Paris.

The consignment, which included "seisMAC" and other geophysical equipment manufactured by the TI Industrial Instrumentation division, consisted of 22 boxes with a total weight of nearly 6000 pounds and a value of approximately $185,000.

It was purchased by Seismos G.M.B.H., a German geophysical company, for use by its wholly-owned subsidiary, the Societe Seismique Gravimetrie with headquarters at 79 Champe Elysees, Paris.

The equipment was flown to Paris from New York by KLM Royal Dutch Airlines after being brought from Houston to New York by Slick Airways. This "seisMAC" (seismic magnetic automatic computer) is the first of four being exported overseas this year.

Weston to Expand; Borg-Warner Subsidiaries May Build on Site

Plans for a multi-million dollar expansion of the manufacturing and engineering facilities of Weston Hydraulics, Ltd. were disclosed today with an announcement that this aircraft component subsidiary of Borg-Warner Corp. has purchased approximately 32 acres of land in Van Nuys, Calif.

The expansion program will be initiated with the construction of a 75,000-square-foot building for the development and production of hydraulic and pneumatic equipment for aircraft, missiles and rock-

Are you drilling a Wildcat Well?

PROVEN GEOPHYSICS

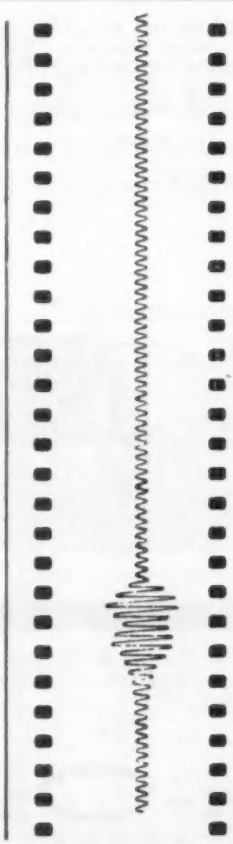
The New and Improved Amazing Attractometer

The latest and most modern method of geophysical exploration that shortens the route to petroleum reserves by rigid instrumental recordings, indicating the existence or not of hydrocarbon accumulations, and approximate depth. Ten locations for a major oil company without error. Surveys conducted for cash fee and chance to earn small override, oil payment, leases or other interest, where saturation is indicated in commercial quantities. Information on request.

To establish conclusive proof of the accuracy of our geophysical work, we will, without cost to you, test and record a log of your well on tape, bearing your signature and ours, of your rank wildcat location, in advance of drilling, indicating the existence or not of petroleum in commercial quantities underlying the tested areas and approximately at what depth it may be found. The instruments are entirely self-operating during testing period.

GEOPHYSICAL SURVEY SYNDICATE

4133 Sunnyslope, Sherman Oaks, Calif. Phone STate 46903



Specimen of log tape indicating saturation with break in zone

FOR RENT in DENVER, COLORADO

- LARGE OPEN OFFICE SPACE* WITH EXECUTIVE OFFICES, SUITABLE FOR BRANCH OR HEADQUARTERS OPERATION. WILL DIVIDE.
- This space is located in the heart of downtown Denver with adequate parking and transportation available.
- Space available includes 14,000 square feet at $3.00 per square foot, plus 4,450 square feet of basement storage space free of charge.
- This rental rate is well below the prevailing rate for this choice location. This space will provide maximum flexibility for any type of business operation.

* Space formerly occupied by TIME, Inc., Publishers of TIME, LIFE and FORTUNE magazines.

For detailed information contact Van Holt Garrett Jr.

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Oil refineries

in many countries successfully equipped their modern plants with B&R Gate Valves, Globe Valves, Swing Check Valves, Safety Valves. B&R Valves are manufactured according to API specifications. Flange dimensions conform to ASA. Materials correspond to ASTM. One trial with our Valves will make you our customer for ever. Please ask for B&R catalog We 110e with detailed particulars on our lines of **oilfield and refinery equipment.**

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GERMANY

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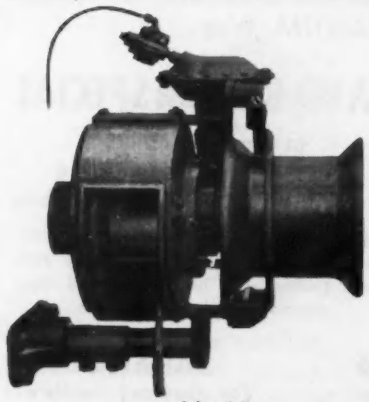
SPECIFY *Foster* CATHEADS when ordering your new Service Rig or Core Drill Rig

A CATHEAD FOR EVERY NEED

Assembly 36
Spinning Cathead
8" cathead spool 12" clutch



Assembly 35
Breakout Cathead
8" cathead spool 12" clutch

To be highly pleased with your cathead performance specify Foster. These catheads are especially designed for use on core drill and cleanout rigs. They are suitable for mounting on lineshafts with a diameter up to 3 inches. These catheads are 19 inches long and 12½ inches in diameter, and have a line pull up to 10,000 pounds. The No. 35 and No. 36 Tiny Masters are equipped with the famous Foster toggle acting means of engaging the clutch plus foolproof single point adjustment. Either the No. 35 or the No. 36 Tiny Master may be used successfully for both breaking joints and spinning pipe. Remember since 1926 Foster has been "first choice of the industry."

Foster CATHEAD COMPANY
P. O. BOX 1351 — WICHITA FALLS, TEXAS
2101 GRANT ST. — PHONE 2-8653

All Foster Representatives carry a complete inventory of spare parts for tongs and all models of Foster Catheads

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Peck Sales & Service ..... Houston, Texas
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Garlick Sales & Service .... Oklahoma City, Okla.
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R. D. Cloninger ..... Lafayette, Louisiana
L. W. Mauck ..... Great Bend, Kansas
W. O. Nelson ..... Farmington, New Mexico
Coastal Engineering Co. .. Bakersfield, California
Moore Sales & Service Company .. Casper, Wyoming
Joe Perry ..... Salem, Illinois
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Bobby Gill ..... Duncan, Okla.
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Langley Y Cia Srl ..... Buenos Aires, Argentina
East-West Oil Tools C. A. ..... Maracaibo & Anaco, Venezuela

PROMPT DELIVERY!

M & V is geared for fast, efficient service with every sale. M & V Treaters, Separators, Tanks, and related equipment are stocked in a complete range of standard sizes and types for immediate delivery.

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Clean Heat Transfer Surfaces Mean

MORE POWER — LESS FUEL — REDUCED MAINTENANCE

You can have them the Safe and Certain SAND-BANUM Way.

SAND-BANUM

Pure Colloidal Concentrate for ALL types of Boilers

Ounces only once a week safely and automatically remove and prevent boiler scale and corrosion without tools, manual labor or shut-downs.
You get more power from less fuel.

SAND-BANUM SPECIAL

In Handy Tablets For ALL Radiator Cooling Systems – Stationary or Mobile

Regular use of Sand-Banum Special maintains the cooling system free from rust, crust, sludge, dirt, oil, grease and lime; any and all clogging matter.

SABCO
Rust Preventive Aluminum paint; 2 coats in one application.

RUSTEND
Clear Rust Arrestor—Rust Preventor.

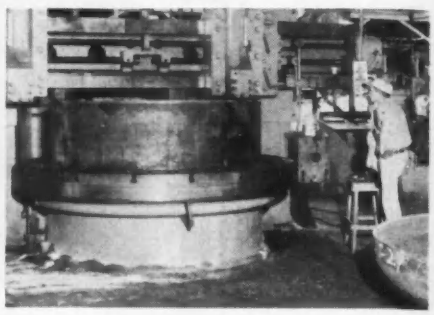
SABANOL
For clean and complete fuel oil burnability.

Stocked by Leading Supply Houses
GULF COAST DISTRICT REPRESENTATIVES
Western Sand-Banum Company, 1717 Chenevert St., Houston 2, Texas

AMERICAN SAND-BANUM CO. INC.
ESTABLISHED 1926
MEADOW BROOK NATIONAL BANK BUILDING
FREEPORT, NEW YORK
SAND BANUM

ets, according to Ira E. Weston, president and general manager of Weston Hydraulics.

Indicating a possible further extension of Borg-Warner's West Coast manufacturing activities, Weston said other Borg-Warner divisions and subsidiaries may erect facilities on the newly acquired Van Nuys site.



Kingsize vertical boring mill machines heads for tank car tanks at The J. B. Beaird Co., Inc.

New Machine Tools Figure In Beaird Expansion Program

Giant machine tools weighing up to 35,000 pounds will do precision work on large diameter parts for custom fabricated products at The J. B. Beaird Company, Inc., Shreveport, La., manufacturer of heavy steel products. Latest and largest addition in Beaird's tooling program is a vertical boring mill with a 108-inch table, one of fewer than 50 of its size in the country, J. Pat Beaird, president, said.

The third heavy machine tool acquired by Beaird in two years, the massive Betts boring mill weighs 35,000 pounds and has a 47-inch clearance under the cross rails, giving it the capacity to cut kingsize diameters.

The mill is presently machining the 6½ foot diameter flanged and dished heads of tank car tanks, one of several new products being built by Beaird. Under a substantial order from North American Car Corporation, Beaird is constructing the specially designed tanks that will be mounted on heavy duty rail underframes and used for transporting petroleum and chemical products and other assorted cargo.

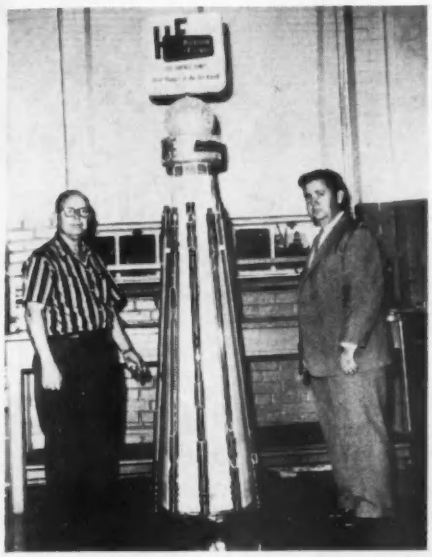
Seismograph Service Gets Navy Contract for $500,000

Seismograph Service Corporation has been awarded a contract in excess of $500,000 for the construction of Lorac transmitting and receiving equipment for the U. S. Navy. Working with shore transmitting stations, this equipment will be used aboard Navy ships for mapping the ocean depths.

Lorac, developed by SSC, is the abbreviation for long range accuracy, and provides for pin-pointing locations at sea through the use of electronic equipment.

SSC President G. H. Westby said the contract is the largest ever placed with the company by the Navy, and is in line with SSC's new policy to move into the field of manufacturing precision equipment, both for the military and for private industry.

Westby said the current contract with the Navy calls for the manufacture of eight complete Lorac shore transmitting networks, consisting of 24 transmitters and 40 receiving units, which will be placed aboard Navy vessels.



Detail pump model donated to Texas A&M enables close studies to be made of the subsurface pumps.

Harbison-Fischer Donates Cut-away to A & M College

The Harbison-Fischer Manufacturing Company, manufacturers of oil well pumping equipment, of Fort Worth, Texas, has presented a display of cut-away model oil field subsurface pumps to the Petroleum Engineering department of A & M College of Texas, for use for instructional purposes.

This display is complete with ten pumps. The pumps are chromium-plated and are full diameter and are constructed so that the salient features and details of construction and operation may be studied.

National Electric Given Rights To A. M. Byers Laboratories

Two of Pittsburgh's oldest firms, National Electric Products Corporation and A. M. Byers Company, have signed an agreement. With President W. C. Robinson, Jr., of National Electric and President B. M. Byers of A. M. Byers formalizing the agreement, National Electric was given exclusive finishing and marketing rights to A. M. Byers' Underwriters' Laboratories approved wrought iron electrical conduit.

National Electric will market the corrosion resistant conduit through its 11 warehouses, 29 district offices and authorized distributors located throughout the U. S.

With the addition of wrought iron electrical conduit, National expands its established product line which includes: Sherarduct, Superduct, Economy and Xduct rigid steel conduit and Xduct Junior electrical metallic tubing.

Coastal Marine's Two Rigs Christened in New York Recently

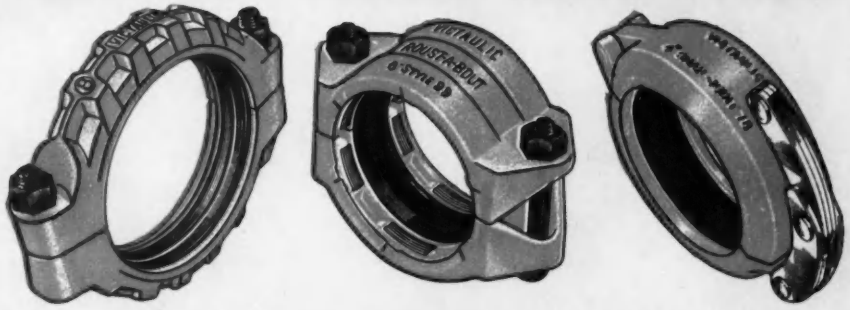
Two highly specialized vessels, designed and built for offshore oil drilling operations in the Gulf of Mexico, were christened recently at New York Shipbuilding Corporation's huge yard on the Delaware River in Camden, N. J.

The ships—a 2500-gross-ton drilling tender and a 297-ton cargo-supply ship—are being built for use by Coastal Marine Drilling and Construction Corporation of Houston. Both self-propelled and entirely self-contained units, the vessels will operate as a highly mobile team—complete

VICTAULIC®

METHOD OF PIPING

VICTAULIC HAS EVERYTHING...

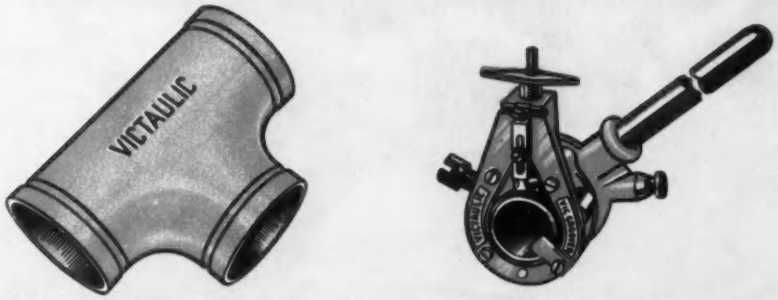


VICTAULIC COUPLINGS
Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".

ROUST-A-BOUT COUPLINGS
For plain or beveled end pipe *Style 99.* Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".

VICTAULIC SNAP-JOINTS
The new, boltless, speed coupling, *Style 78.* Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB



VICTAULIC FULL-FLOW FITTINGS
Elbows, Tees, Reducers, Laterals, *a complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".

VIC-GROOVER TOOLS
Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¾" to 8".

PLUS FITTINGS AND GROOVING TOOLS

"EASIEST WAY TO MAKE ENDS MEET"

Promptly available from distributor stocks coast to coast.
Write for NEW Victaulic Catalog-Manual No. G-10

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

For more data on advertised products, use Readers' Service Cards, last page.

Cost-cutting Performance

28 YEARS OF SERVICE
TO THE PETROLEUM INDUSTRY

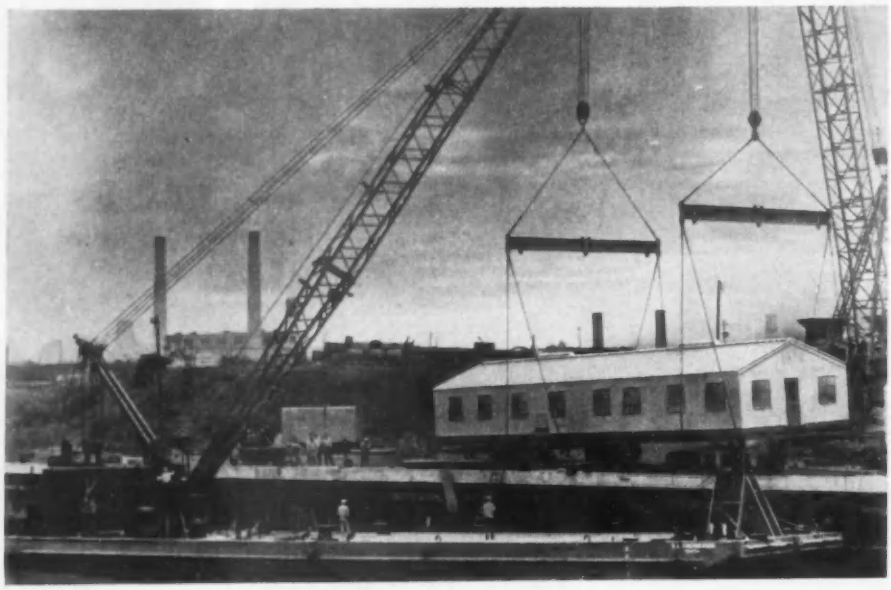
CP ROCK BITS . . . th

. the best by far for footage

Chicago Pneumatic Fort Worth, Texas

with a helicopter port atop the tender's bridge deck.

Named in honor of her husband who is president of Coastal Marine Drilling and Construction Corporation, the drilling tender will be christened by Mrs. Howard S. Cole, Jr., of Houston. The cargo-supply vessel, named the Irwin W. Alcorn, will be christened by Mrs. Alcorn. Alcorn is vice president and general manager of the same firm.



For Louisiana Oil Fields

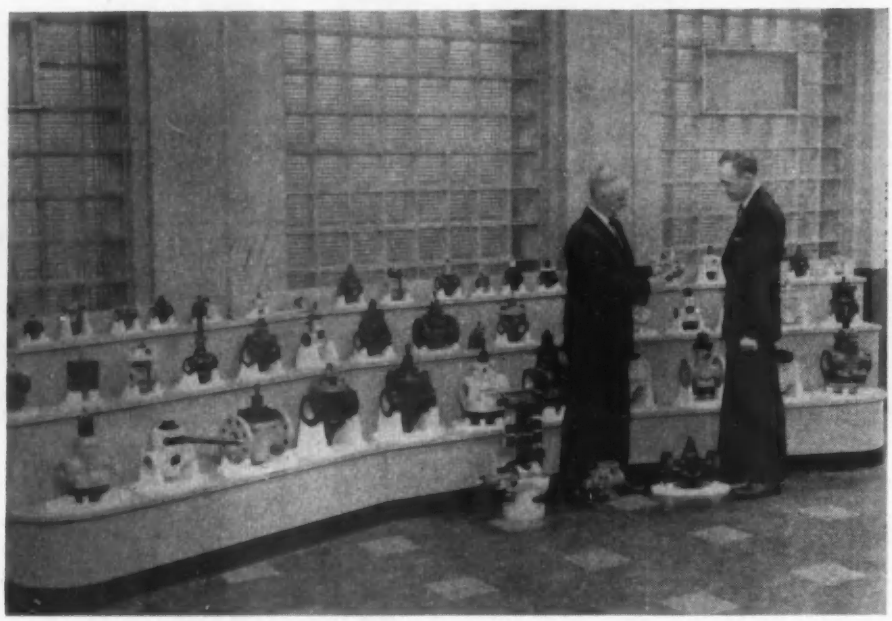
A completely assembled Armco steel building is being lifted onto a barge used by Brown & Root, Inc., Houston, for work in the coastal oil fields of Louisiana. The 24 foot wide by 72 foot long structure will serve as quarters for the crew.

Wyatt Metal & Boiler Buys Plant in Mexico City

Wyatt Metal & Boiler Works, Inc. has purchased the plant of Productos de Hierro y Acero, SA, a metal fabricating concern with headquarters in Mexico City.

T. J. Uhl, who was production manager at Wyatt's Dallas plant, has been named manager of the Mexican concern, which will be operated as a wholly-owned subsidiary of Wyatt's.

The plant outside of the Mexican capital is equipped to do fabrication similar to that produced in the Houston and Dallas shops of the parent concern. These facilities are not capable of turning out the complicated fabricated products commonly manufactured in the Texas plants.



Rockwell Valves on Display

Ernest Fallows, assistant general manager of the Barberton plant, shows Thomas Gettig, assistant to the vice president in charge of Rockwell's Meter and Valve division, a cutaway model showing one of the design refinements made in the progress of the valve. In the background is the Rockwell Museum.

Timken Company Construction In Australia to Begin Soon

The Timken Roller Bearing Company has announced that formal negotiations with the state government of Victoria, and the federal government of Australia have been completed and construction of a new $1½ million Timken Company plant would get underway immediately. This phase of the company's building program will include a manufacturing plant containing 30,000 square feet of floor space with a producing capacity of 1,000,000 bearings a year. Output of this plant will be supplemented by bearing shipments from the U. S. in order to afford a complete range of bearing sizes to Australia, New Zealand and the Far East.

Elmer Schweitzer, The Timken Company's manager of its Zanesville, Ohio, operation has been named managing director of Australian Timken Proprietary Limited, the corporate name of the company's Australian operation. The members of the board of directors of the Australian corporation are: Elmer Schweitzer, managing director, Walter Jehu, formerly manager of the Timken Company's Boston office, William E. Umstattd, president, H. H. Timken, Jr., W. R. Timken and D. A. Bessmer. Acting secretary of the new firm is Australian lawyer, Beamish Brett.

International Harvester Plans New Used Equipment Concept

The Construction Equipment division, International Harvester Company, has announced a new plan for selling used equipment through its distributors. This program is called VM (Value Measured) Used Equipment. It represents a new concept in used construction equipment selling and buying.

Under the plan, the International distributor reconditions or rebuilds a used machine and then measures the value of each major component such as engine, transmission, clutch, tires or tracks, final drive and other vital areas. The value of these components is derived by estimating the condition of the part if it is acceptable as is, or by listing the repairs and their cost on component tags which the distributor attaches to the machine.

After the VM used machine is put in the used equipment lot, the prospective buyer has only to walk around the machine and check the condition or value of each component by reading the tags.

Clark Opens New Branch Office; John Cooper Is Branch Manager

Clark Bros. Co. of Olean, N. Y., announced the opening of a new, modern office and warehouse facilities in New Orleans.

John Cooper, branch manager, will live in Metairie, La. Prior to his present appointment Cooper lived in Tulsa where he served as a district sales engineer for Clark.

Vercellino Is in Charge Of San Antonio Lane-Wells

The Lane-Wells Company has announced the opening of a new sales office in San Antonio, Texas.

W. C. Vercellino, Gulf Coast division mechanical engineer, has been appointed district sales engineer in charge of the San Antonio office. He joined Lane-Wells in 1950 at Colorado City, Texas, as a rigman. Prior to his present appointment he work at Colorado City, Snyder and Houston.

WORLD OIL'S Trading Post CLASSIFIED ADVERTISING

RATES: Regular Classified (undisplayed) set in this size type: 20 cents per word. Minimum charge $4. Blind box address in our care counts six words. Replies forwarded without charge. **Display Classified ads,** set in suitably larger type with ruled border, $13.50 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. **All classified ads payable in advance.** Send copy and checks to: Trading Post Classified Section. World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

BOILERS

4—150 HP 350# WP Lucey Oilfield Boilers complete with burners, stacks, all connections. Texas Operating Certificates good until June, 1958. Inspection invited. Located in Houston, Texas.

HOLMES DRILLING COMPANY
1045 San Jacinto Bldg. • Houston, Texas

Rigs For Sale

Purchase Cardwell used rigs from Cardwell Investment Co., Inc.; 604 Petroleum Bldg.; Wichita 2, Kansas; Phone AM 5-2611.

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■ Delaware Corporations formed and serviced Inquire without obligation. American Guaranty & Trust Company, 910 West Street, Wilmington, Delaware.

■ INCORPORATE in Nevada for oil and mining projects. Do business anywhere. Positively no liability of organizers and stockholders. Over 25 years experience. Financing assistance at no additional cost. Write for Resume. L. O. Goodman, L.L.B., Box 991, Globe, Arizona.

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WORLD WIDE SERVICES:

Detection and location through radiation.
Oil, Gas, Water, Minerals.
Exclusive Agent for German Strahlen "Cymoscope".
Geochemical Soil Analysis.
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Geodynamic Petroleum Prospecting.

Of Special Interest to All Oil Prospectors:
Write for Our Free Pamphlet
"MODERN PETROLEUM DETERMINATION"

GEOPHYSICAL EXPLORATION GROUP
Taft Building, 1680 N. Vine St., Hollywood 28, Calif.

Well organized, well established oil-well drilling contractor desires the management and supervision of oil properties in West Texas, Central Texas, and New Mexico. Can provide complete handling of oil properties from acquisition to production. No properties too small, and none too large to handle. Inquiries from independents, groups, small or medium sized oil companies invited. Write, wire or call collect for further information.

MAKIN DRILLING COMPANY
P. O. Box 1628
Hobbs, New Mexico
Phone: EXpress 3-3141

SOHIO PETROLEUM Company, Operator, solicits offers to buy its working interest in the Sallyards Water Flood, Butler County, Kansas. Total Gross production from Bartlesville Sand was 2,220 barrels in July, 1957. Average depth wells—2550 feet, 18 producing, 18 water input, water system and electric system. The other working interest owners have indicated they may be willing to sell their interest. For inspection and complete specifications contact: Sohio Petroleum Company, Box 9637, Oklahoma City 18, Oklahoma, Attention: J. E. Buckley, Phone Victor 3-1544.

HELP WANTED

PETROLEUM ENGINEER
College Degree; 5 years Drilling and Production Experience, offshore preferred. Good salary.

NAVAL ARCHITECT
College Degree; 5 years Design Experience. Key positions, Developing Floating Drilling Techniques and Equipment. Growing, Aggressive Drilling Company located in Houston. **Our Fee Is Paid**

PACE BUSINESS SERVICES
234 Esperson Bldg. Houston 2, Texas

POSITION OFFERED
Seismograph Technician with thorough field practice, fully conversant with recent developments and interpretation, wanted to assume responsibilities of field supervision and interpretation, by French concern exploring in Libya. Furnish full information on education, experience, salary. Box 139-W, WORLD OIL, Houston, Texas.

■ WANTED: A capable and sober man that can sell contracts, do field surveys, and make rough drafts of field work on a gamma ray contract unit. Prefer man with geologic field experience. Will consider giving a percentage instead of salary. Box 140-W, WORLD OIL, Houston, Texas.

Accountant and Office Manager. Preferably in middle or late thirties who can accept responsibility for all financial accounting, bookkeeping and tax operations and policies of independent producer in midcontinent area. Excellent opportunity for right man. Salary $8-10,000 depending upon qualifications. Box 138-W, WORLD OIL, Houston, Texas.

TENNESSEE GAS TRANSMISSION COMPANY
has career opportunities
for
PETROLEUM ENGINEERS
for its expanding oil and gas production operations. Must have B.S. or M.S. in Petroleum Engineering and 2 to 5 years experience in Production Engineering. Age to 35. Send complete personal history including education and description of experience to:

John Fry, Employment Manager
Tennessee Gas Transmission Company
P. O. Box 2511
Houston, Texas

(All replies will be held in confidence)

BUSINESS OPPORTUNITIES

■ MAJOR OIL COMPANY, Western North Carolina. (12 outlets: 2 owned & 10 lsed.) A HALF MILLION in sales! (Some retail accts) Compl. eqpt. for all! Expan. oppty & unlim. potential! Write 4 details & photo. Ref. 9019.

WHLSLE PETROLEUM—NE Fla. Full eqpt. $200,000 gross plus $10,000 comm. Great optty. Det. on Req. Ref. B9246.

OIL & GAS PRODUCTION—S. Illinois. 28 oil wells, top prod. oil leases. Pot. unlim. wk entire US. Geological dept. Ask $55,000. Write for details. Ref. B62297.

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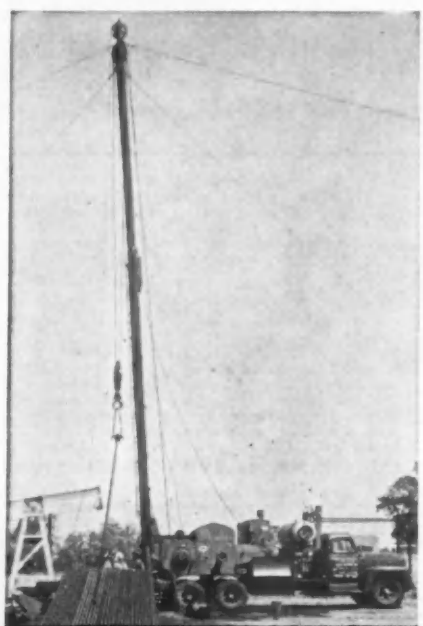
Classified Ads
Don't Cost—
They Pay

EXTRA
Fast Pay-Out

EXTRA
Long Life



WICHTEX
Well Servicing Units

Wichtex units are outstandingly profitable to own. They are fast and efficient, and provide extra capacity per dollar invested.

They help you secure . . . and keep . . . good customers by assuring prompt, dependable service. They are reasonably priced, and pay for themselves in a very minimum of time.

And, Wichtex units are in a class to themselves for long, economical, trouble-free life.

Write for catalog. Eight models range from 2,000′ to 12,000′ capacity. All models can be equipped with spudding attachment.

Also investigate Wichtex Rotary Rigs for 2,000′ to 5,000′ drilling.

WICHTEX MACHINERY COMPANY INC.
WICHITA FALLS TEXAS
Box 2250 Ph. 2-8612

SQUEAKS from the BULLWHEEL

"I know they went broke drilling wells at half price, but look at the money we saved."

Watch That Road

With Violet cuddling in his arms,
He drove a car—poor silly.
Where he once held his Violet,
He now holds a lily.

Caught

"I just met your friend Joe, and he had a pinched look."

"What was the matter?"

"Oh, he was walking between two cops."

Wealthy Texan?

Sign on the back of a Houston station wagon: "No ranch, just kids!"

Ah, TV

TV Announcer: "We have just received a bulletin of a catastrophe, the like of which has never been known to mankind —but first, a word from our sponsor."

Anything for Free

A Seattle chest X-ray worker thought she saw a familiar face in the line of persons being X-rayed, so she asked the woman if she hadn't already been tested.

"Certainly," replied the woman. "I've had three already. The first treatment didn't help me, but after the second one I began feeling a lot better. I don't have to quit them, do I?"

Southern History

In a Dallas author's book, "The Real Facts About Appomattox," the Texan sees the end of the Civil War this way. "After chasing the Union Army all over the map, the exhausted Confederates pulled up at Appomattox, planning to wipe out the Yankees next day, march into Washington and raise the Stars and Bars over the White House.

"General Lee was resting at the town's court house when in walked General Grant ready to surrender. Lee took the unimpressive Union general to be an orderly, so he gave him his sword to polish. Astonished, Grant took the sword, thinking Lee had surrendered instead. He even thanked Lee for surrendering, and being a true Southern gentleman, Lee couldn't go back on his word."

Birds, Birds Everywhere

Two duck hunters were sitting behind their blind, one drinking from a thermos of coffee, the other from a jug of whiskey. After some hours of sipping they spotted a lone duck winging through the sky. Tak-

Over
70
Locations in the United States and Canada

McCullough® REPORTS TO THE OIL INDUSTRY

Service
Anywhere Anytime

New Services • • • New Tools • • • New Methods • • • Outstanding Results

Powerful M-3's Perforate Deep Well for 1296 B/D

McCullough M-3 Bullet Guns Get Production After Jets of Another Make Fail

This deep well in New Mexico had previously been jet perforated by another service company without results.

Producing formation was a 26′ zone between 11,977′ and 12,003′. 5½″ OD 20 lb. casing had been cemented through the zone.

McCullough was called to reperforate the well with M-3 Bullet Perforators. 156 improved ½″ Ogival Bullets, six per foot, were fired in the 26′ interval.

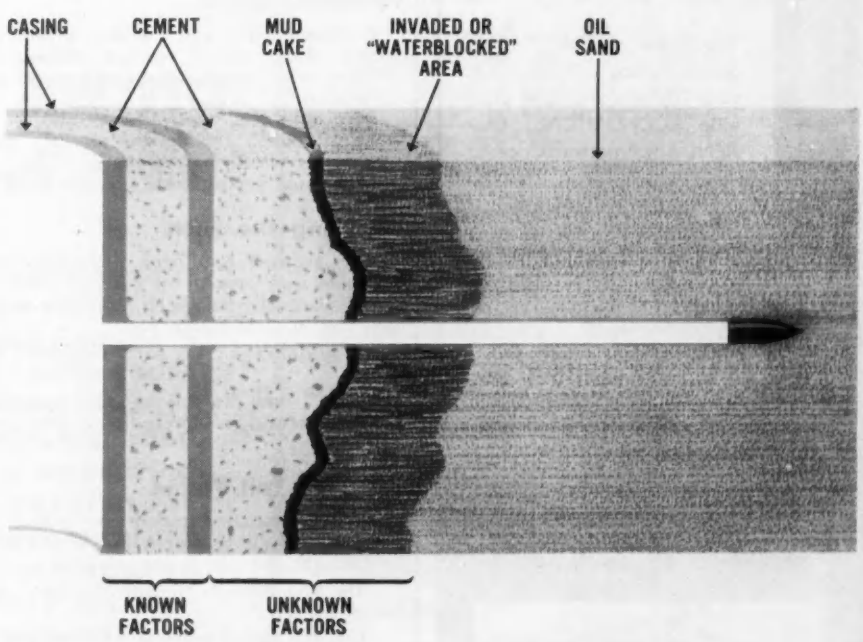
Resulting production was 1296 barrels of oil per day. Operator was very pleased with the good results of the job.

McCullough M-3 Bullet Guns are made to shoot harder—to obtain deepest penetration under severe well conditions. M-3 Guns will get production or increase production even after others have failed.

The job shown above is certified to be a true field report of service rendered.

For full information on the McCullough M-3 Bullet Perforator, write to:

McCullough Tool Company
5820 South Alameda
Los Angeles 58, Calif.



HARDEST SHOOTING M-3 BULLET GUNS
"PUT THE SHOTS WHERE THEY COUNT"—DEEP IN THE OIL ZONE

M-3 Guns are designed to obtain the deepest possible penetration. They have the extra firing power necessary to pierce the known thickness of multiple casing strings with cement in the annulus—to penetrate through an unknown thickness of cement outside the casing—to get through the variable depth of a mud cake and "water blocked" area—to penetrate deep out into the virgin oil zone.

Because they shoot harder, McCullough M-3 Guns get the results you want—better production—more oil! Size for size, M-3's consistently outshoot all other makes of bullet guns.

McCullough® TOOL COMPANY
Cable Address: MACTOOL

LOS ANGELES
HOUSTON
EDMONTON

The NEW REDA "450" SERIES PUMPS

provide more oil per dollar invested

- 250-600 B.P.D.
- 900-4,400 Ft. Lift
- For 5½" or larger Casing Sizes

The new REDA "450" Series Pumps will REDUCE your lifting costs, and provide ECONOMICAL, DEPENDABLE performance.

- LOW INITIAL COST
- AUTOMATIC OPERATION
- LOW OPERATING COST
- LOW MAINTENANCE REQUIRED
- CORROSION-RESISTANT CONSTRUCTION

WRITE TODAY FOR REDA R-450 BULLETIN!

LARGER PUMP SIZES AVAILABLE

SIGN OF QUALITY OILWELL REDA PUMPS

REDA PUMP COMPANY
BARTLESVILLE, OKLAHOMA
Manufacturers of Submergible, Electric Motors and Pumps for Over 35 Years.

"You're hired!"

ing quick aim, the coffee drinker rose, let fire and missed. The whiskey drinker rose, let fire and brought the bird down. His companion, properly amazed, complimented him on the shot. He replied, "Aw, it's nothing. I usually get five or six in a flock like that."

Patience, Doctor

A doctor, who was teaching a Sunday-school class, asked one of the boys: "Willie, what must we do before we get to heaven?"

"We must die," answered Willie.

"Very true," replied the doctor, "But what must we do before that?"

"We must get sick and call for you."

Pleading the Fifth

The accused had been duly convicted when it was proved on further evidence that he actually had been in prison at the time the act was committed.

"Why didn't you say so?" demanded the judge.

"Well," said the prisoner apologetically, "I was afraid of prejudicing the jury against me."

Another Tall Texan

A Texas rancher traded his Cadillac in on a new Rolls Royce. A few weeks later he brought the car in for servicing.

"Do you like it all right?" asked the salesman.

"Oh, it's fine. I especially like that glass partition between the front and back seat."

"You do?"

"Yeah, keeps the cows from licking my neck when I'm taking them to the stock shows."

Hey, Pa!

Two small boys were trying to awaken their father, taking a snooze on the sofa. They hollered and pushed him. He didn't budge. Finally one of the boys lifted one of his dad's eyelids.

"I don't know why he doesn't answer," he said. "He's in there."

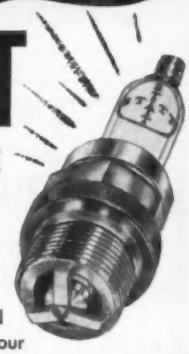
Try and Do It

"Where are you going on your vacation?"

"Haven't decided yet. I want to take a

Here's the spark plug for CLARK® ENGINES

STITT NEW TRIPLE IGNITORS



Clark is now factory-installing STITT new Triple Ignitor Spark Plugs in Turbo Charged engines . . . Bring your Clark engines up to date—repower them with STITTS which give you longer life, cut downtime, increase magneto life. STITTS are also factory equipment in Waukesha, Cooper-Bessemer, Worthington, other leading engines

Write today for FREE pocket booklet giving recommended plugs for all engines—you can get better plug performance.

STITT IGNITION CO.
COLUMBUS 1, OHIO
STITT MAKES HEAVY-DUTY, INDUSTRIAL-TYPE PLUGS!

SECONDARY RECOVERY
Since 1922
PETROLEUM ENGINEERS
CABLE ENGINEERING
WICHITA FALLS, TEXAS
RESERVOIR ENGINEERING
Water Flooding Gas Repressuring
EVALUATION CORE ANALYSIS
SURVEYS ECONOMICS
Cost Estimates, Design, Installation
FIELD SUPERVISION
Phone 3-2167

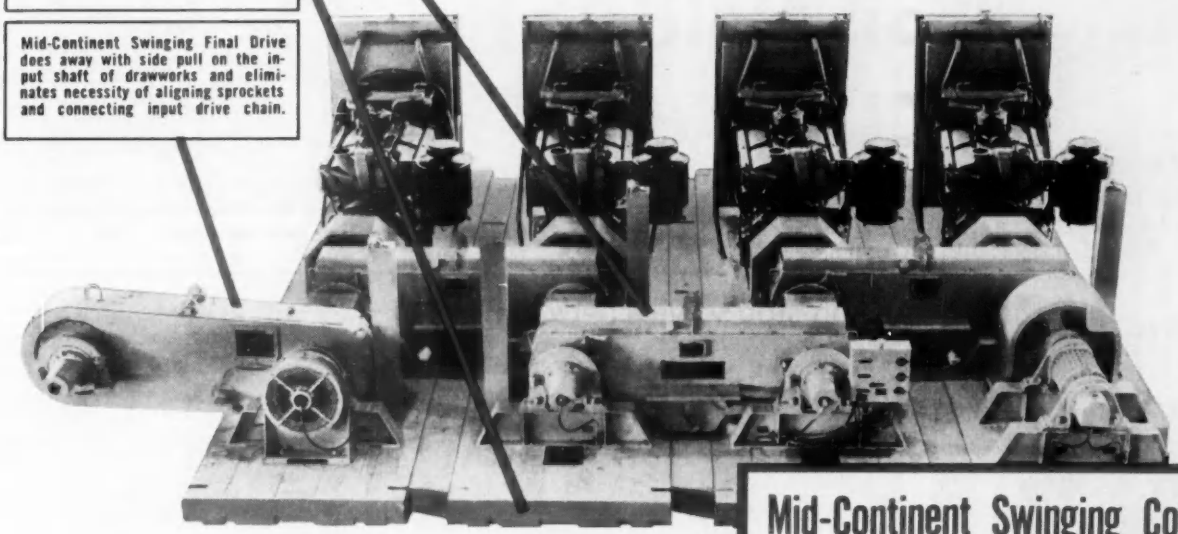
HYDROCARBON WELL LOGGING (WORLD WIDE)
SPECTROMETRIC and CONVENTIONAL
CARAN ENGINEERING CORPORATION
MILAM BLDG. SAN ANTONIO
Branch Offices: Houston and Alice, Texas and Lafayette, Louisiana

Exclusive Swinging Compounds make moves possible without opening compound cases, draining oil, or "breaking" chains. Dust-proof, oil-tight compound cases are of heavy welded construction. Chains are lubricated from individual oil pumps.

Extra-heavy, four-runner skidded units are within eight-foot highway width limits and have dowel pin connections for perfect alignment.

Mid-Continent Swinging Final Drive does away with side pull on the input shaft of drawworks and eliminates necessity of aligning sprockets and connecting input drive chain.

MID-CONTINENT AE RIG DRIVE



Compounds Swing

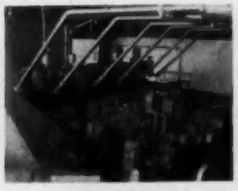
for easy moving...quick rig-up!

Designed for most any engine—drawworks combination, the Mid-Continent AE Rig Drive helps keep non-rotating time to a minimum. Exclusive *Swinging Compounds on all Mid-Continent AE Rig Drives simplify moves and rig-up. Within minutes, compounds can be swung from operating position to vertical locked position for moving, or from vertical to horizontal for drilling. Swinging Final Drive (input to drawworks), specified for many installations, adds still more to the versatility of this practical and dependable Rig Drive. See your Mid-Continent representative today about a Mid-Continent AE Rig Drive for your rig.**

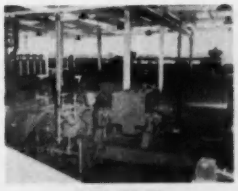
*Patented

Mid-Continent Swinging Compound* Proved in 10 Years World-Wide Service

1947



1951



1955

1957

In 10 years of world-wide service, the Mid-Continent Rig Drive has proved its superiority of design in practical multiple engine drive applications. More than 100 Mid-Continent Rig Drives have been specified by oil companies and drilling contractors for their world-wide drilling operations.

MID-CONTINENT SUPPLY COMPANY

MID-CONTINENT BLDG.
FORT WORTH, TEXAS

Export Division: 45 Rockefeller Plaza, New York 20, N. Y., Cable: MIDCUMPORT NYK

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

Delta DC-7's link the oil fields of CUBA and VENEZUELA

with non-stop service between
HAVANA-CARACAS
one-stop service between
NEW ORLEANS-CARACAS

Deluxe *Royal Caribe* DC-7 through-planes daily between Chicago and Caracas. Dovetail connections at New Orleans to and from all points in mid-America and the West Coast. Depend upon Delta's *Golden Crown* DC-7's to keep pace with the fast-growing needs of the oil industry.

FLY THE RADAR-EQUIPPED
Royal Caribe
Golden Crown DC-7's and DC-7B's

Through the magic of Radar, your Captain can "see" ahead up to 150 miles, select the smoothest course.

One of America's Pioneer Scheduled Airlines
Delta AIR LINES

Serving 60 cities in the U.S.A. and the Caribbean
General Offices: Atlanta Airport, Atlanta, Georgia

WORLD OIL

"At least ya oughta be decent enough ta wake a guy up before you take her down."

trip around the world, but my wife wants to go someplace else."

Eyes Right

Some men never need glasses—they drink right out of the bottle.

Tricky Reasoning

A man should work eight hours, play eight hours, and sleep eight hours. But they shouldn't be the same eight hours.

Hint to Golfers

Golf balls will last longer if kept in the refrigerator during the summer.

Sparking Spots

Coed: The boy I went riding with last night saw dark spots in front of his eyes.
Roommate: What did he do?
Coed: Parked in one of them.

Agreeable Prayers

A small boy was very imaginative and tended to exaggerate wildly as a result. One day he rushed into the house and said he had just seen a bear in the back garden.

"Ricky," said his mother severely, "you know it wasn't a bear at all, but just a big dog. Now go up to your room and kneel down and pray to God to forgive you for telling a lie."

After a few minutes, the boy came downstairs again.

"Did you ask God to forgive you?" asked his mother.

"Yes," said Ricky, "and he said it was all right. He said he thought it was a bear himself when he first saw it."

Think of This!

People who complain about the boss being dumb never realize that if he was any smarter they'd be out of a job.

The Natives Are Restless

Explorer: "There we were surrounded by natives. They uttered savage cries and beat the ground with their clubs."

Bored listener: "Golfers probably."

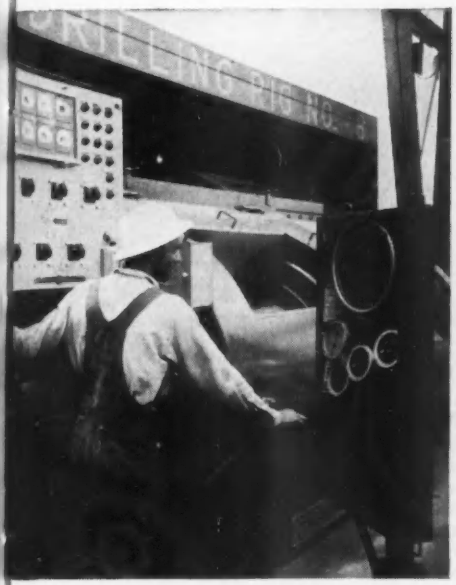
Maid's Days Off

One housewife to another: "With my completely automatic kitchen and laundry, I let my maid go and hired a mechanic."

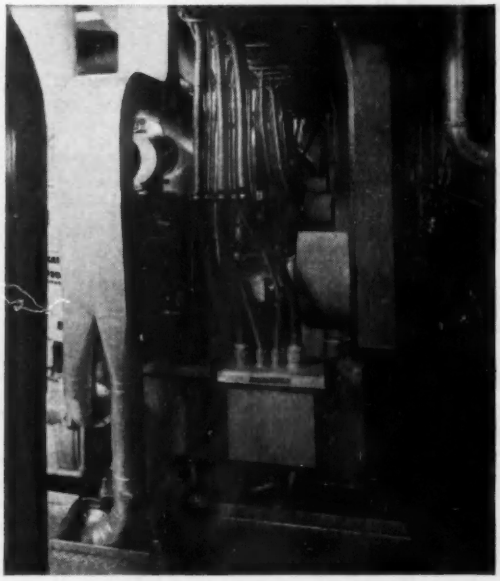
READY TO DRILL WITHIN 1½ DAYS, rapid rig-up was made possible by the portability of a G-E electric drive. Above, drawworks near derrick floor.

INCREASED FLEXIBILITY was gained with the use of G-E drive. Power skids with Cummins LRT-600 TURBODIESEL engines, G-E generators can be located "practically anywhere."

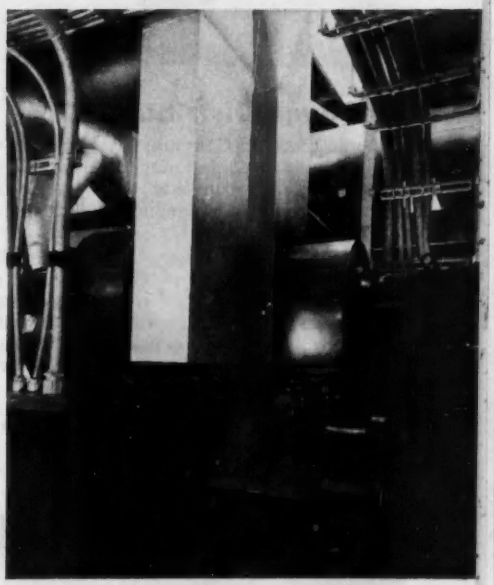
POWER CONNECTIONS ARE MADE QUICKLY with flexible cables, helping Great Western Drilling Company to speed operations.



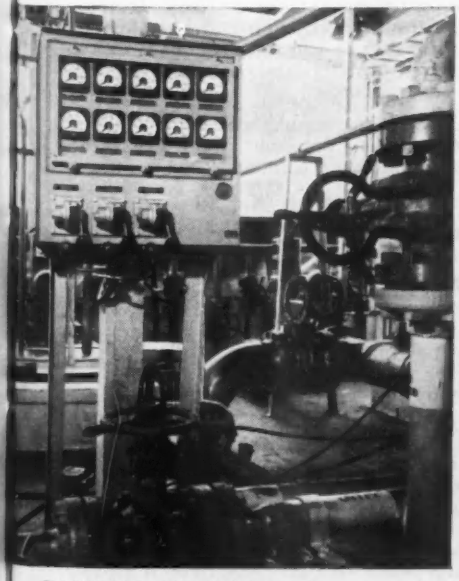
COMPACT G-E DRILLER'S CONSOLE gives operator better control of all electrically driven functions. Indicating ammeters, voltmeters are easy to read.



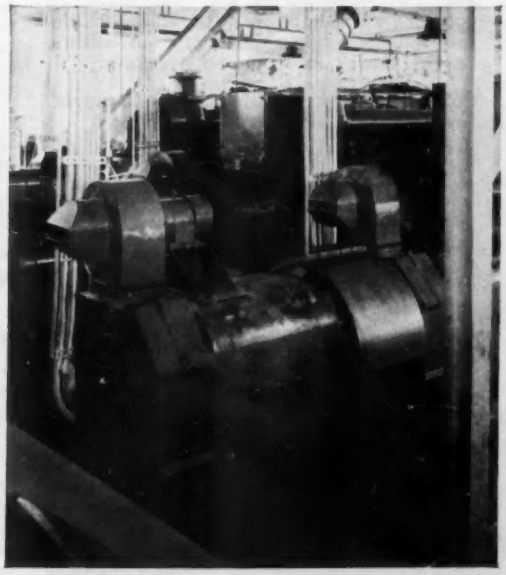
G-E 752J GENERATORS MATE PERFECTLY with Cat. D397 engines to produce reliable electrical power. Generators are reliable, easy to maintain, and have long life features.



EASIER EQUIPMENT SERVICING is made possible with G-E drive because power connections are flexible, can be easily broken.



FAMILIAR AIR THROTTLES mounted on General Electric-built pump room operator's console permit fast, accurate pump control.



COMPLICATED CONTROL DEVICES ARE ELIMINATED aboard Creole's C228. Six G-E 752 drilling generators and seven G-E 752H motors have "built-in" control, protection features.

CONTROL DEVICES ARE EASY TO SERVICE. Main d-c control cabinet has only simple contactors, relays, resistors and air valves.

What's New In Equipment and Services

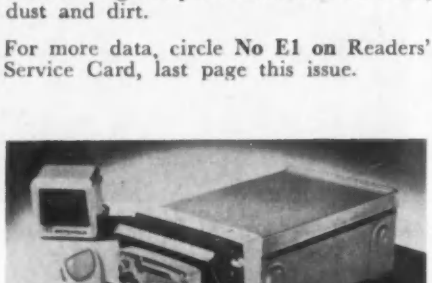
Drilling • Production • Exploration

Improved Distributor Cap

Wico Electric Company, a Division of Globe-Union Inc., announces a new heavy-duty distributor cap that they claim will increase magneto wear-life and improve ignition performance.

A cap made of this new brown phenolic material, withstands a 100 percent humidity atmosphere without breakdown, three times longer than previous materials. This new distributor cap affords the utmost in magneto protection from moisture, dust and dirt.

For more data, circle **No E1 on** Readers' Service Card, last page this issue.



Transistorized Power

Using all-electronic power supplies, a new line of mobile radio units recently announced by Motorola eliminates vibrator replacement problems. Called the T-Power radiophones, the new two-way radio units incorporate a transistorized switching circuit in the power supply in place of the conventional vibrator.

T-Power radiophones offer new installation versatility. The radio drawer is interchangeable between dash or trunk mounted installation. For trunk mounting, the plug-in control head is easily removed from the radio.

These models can be supplied with either conventional squelch or as private-line radiophones which prevent the reception of nuisance noise and messages originating outside the private-line radio system.

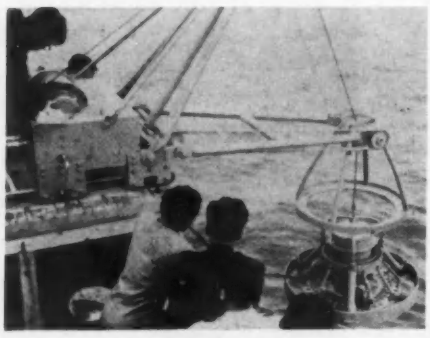
For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Broad Band Radio

An inexpensive radio-telephone system which bridges telephone service over terrains where it would be physically or economically impractical to install telephone lines has been developed by Allen B. Du Mont Laboratories, Inc.

Designated the Du Mont MCA-47-B Three Channel Mulitiplex Station, the equipment utilizes broad-band, point-to-point radio in the ultra-high frequency range of 450 megacycles. In addition to being ideally suited for permanent and temporary telephone installations, operation in the UHF band makes the equipment advantageously adaptable as a broadband two-way radio system, a multichannel radio communications unit (carrying up to 54 teletype channels), or as the transmission facilities for slow-scan industrial television.

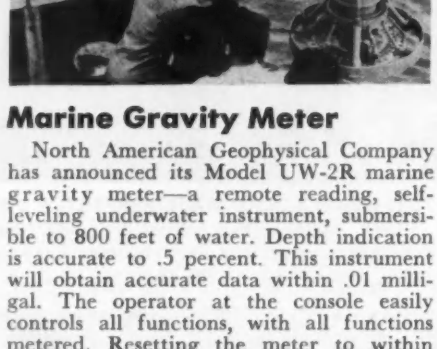
For more data, circle **No. E3** on Readers' Service Card, last page this issue.



Marine Gravity Meter

North American Geophysical Company has announced its Model UW-2R marine gravity meter—a remote reading, self-leveling underwater instrument, submersible to 800 feet of water. Depth indication is accurate to .5 percent. This instrument will obtain accurate data within .01 milligal. The operator at the console easily controls all functions, with all functions metered. Resetting the meter to within reading range is simple and positive.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.



Water-Repellent Cloth

A new double-surfaced water-repellent tracing cloth, No. 378WD Whitney, is now offered by Charles Bruning Company, Inc.

This specially prepared, double-surfaced white tracing cloth allows unchanging parts of a drawing (such as building shells, streets, etc.) to be drawn on one side of the cloth, and details which may be subject to repeated revision (such as plumbing, utility lines, etc.) to be drawn on the other side. Erasures are made easily on the detail side, without danger of removing information from the other side.

The cloth is impervious to perspiration stains and water spotting, and can be cleaned with common solvents without damage. It can take pencil lines as hard as 9H and repeated erasures without surface damage.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Heavy-Duty Truck Line

Two more heavy-duty all-wheel-drive models have been added to the International Harvester truck line.

Model R-190 (4 by 4) is rated at 29,000 pounds gvw, and is available in four wheelbases from 142 to 193 inches. Model RF-190 (6 by 6) is available with choice of bogies to provide gvw ratings of 38,000 or 43,000 pounds. Four wheelbase lengths range from 157 to 221 inches.

The new four and six-wheel drive models complete a line of specialized light, medium and heavy-duty International trucks designed particularly for off-highway service where heavy loads are to be moved over terrain requiring maximum vehicle traction.

(This item supplements International Harvester Co. data on Pages 2742-2745 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Normalizing Kit

The reduction of engine horsepower caused by operation at high altitudes can now be eliminated on the Caterpillar D8 tractor by the use of a Normalizing Kit recently introduced by Caterpillar Tractor Co.

The new kit, which consists of a turbocharger and all manifolds and adaptors need to mount it on the tractor engine, overcomes the cause of high-altitude power loss—insufficient oxygen to permit complete combustion of fuel. The turbocharger delivers air to the inlet manifold at greater than atmospheric pressure, thus permitting

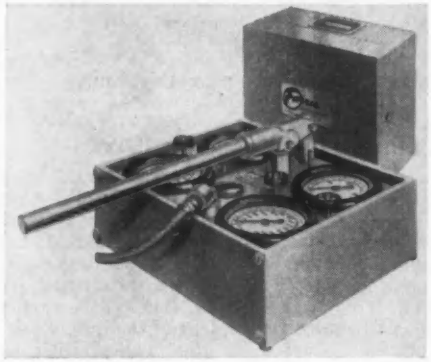
complete fuel combustion and restoring "sea level" hp up to 10,000 feet altitude. For example, when operating at an altitude of 8000 feet, the normalized D8 will operate at the machine's sea level rating of 191 hp, while the standard D8's capacity at the same altitude would be 151 hp.

The Normalizing Kit does not increase the sea level hp of the tractor, but serves only to provide the needed oxygen to burn the same amount of fuel at high altitudes as at sea level.

(This item supplements Caterpillar Tractor Co. data on Pages 1210-1212 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

PRODUCTION



Utility Porta-Tester

A utility version of the new Farris Porta-Tester, weighing only 55 pounds and contained within a carrying case, has been developed by the Farris Engineering Corporation for general industrial use in at-the-site hydrostatic testing of valves, pressure vessels, piping, steam generators, pump cases and other process equipment, to pressures up to 3000 pounds per square inch.

The completely portable unit is only 18 inches by 14 inches by 8 inches and can be carried about like an overnight case. It is complete with four test-accuracy gages and eight feet of hydraulic, flexible tubing that packages on the rear of the cover for complete portability. The pump handle folds flat for easy storage in the case. The unit can be used with water or other hydraulic fluids.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Jet Fuel Pump

The Reda Pump Company recently introduced its new jet-fuel pump. This new line of Reda pumps, designed to handle aviation jet fuel and gasoline are now in use for fueling jet planes.

The Reda Jet-Fuel pump is engineered to pump aviation jet fuel and gasoline from underground storage tanks, without any above-ground installation or structures. Exclusive advantages include: no priming, no vapor locks, no stuffing boxes, no explosing hazards and no horsepower or pressure limitations.

(This item supplements Reda Pump Co. data on Pages 4537-4540 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

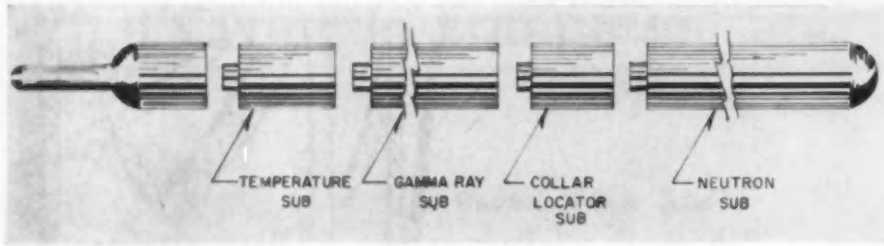
DESIGNERS AND BUILDERS— DRILLING BARGES, WORK BOATS, TUGS, RIVER BARGES, ETC. QUICK MARINE REPAIRS AND SERVICE—TWO DRYDOCKS, MACHINE SHOP, GAS FREEING, SAND BLASTING, PAINTING, ETC.

American Marine is especially interested in speed and economy when it comes to marine repairs. American Marine is privileged to offer you large capacity drydock and machine shop facilities in constant service manned by marine technicians who know the ROPES.

AMERICAN MARINE CORPORATION

Formerly Alexander Shipyard

P. O. BOX 8126, NEW ORLEANS 22, LA. VALLEY 2408



• Temperature		— going into hole
• Gamma ray	2″/100′ scale	— coming out
• Gamma ray	5″/100′ scale	— coming out
• Neutron	2″/100′ scale	— coming out
• Neutron	5″/100′ scale	— coming out
• Casing collar		— coming out

New Logging Technique

Six logs can now be produced on a single run into the well with a new package-type tool introduced by Worth Well Surveys. Use of two dual recorders, installed in the instrument truck, make the above log combination possible.

The two dual recorders permit the running of the standard two inch per 100 feet scale and the detailed five inch per 100 feet scale on the gamma ray, neutron, and casing collar log curves simultaneously. These new dual recorders were designed and built by Westronics, Inc., specifically for well logging operations, with proper chart drive provisions, pen speeds and compact dimensions.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Horizontal Fracture Process

A new concept and process to control formation fractures was introduced August 1 by The Western Company of Midland, Texas. The tool and process, known as "FI," was developed over a two-year period and field tested in 52 wells. The process is restricted to use inside casing on new zones. Zones previously perforated, squeezed, fractured or heavily acidized would necessarily be eliminated as the stress pattern necessary to produce a controlled fracture might be effected.

The FI tool can be run to the predetermined level where it is desired to initiate the fracture. The tool when detonated blows into small fragments leaving three parallel holes in opposite directions in a horizontal plane with a total of six holes. Key to development of the new tool was the proper spacing between holes and hole diameter. Fracturing is then employed in a conventional manner with a special frac-fluid spotted across the zone to be fractured. The stress pattern set-up from this critical hole diameter to hole spacing ratio will cause fracturing between holes on a horizontal plane. As fluid is pumped into the formation from the initiating point of fracture, the fracture is extended by relative infinite stress at the extremity of the fracture.

The process showed successful results in thin zones where it was desirable to keep the controlled fracture within the oil column and out of the gas or water contact. The FI process can also be modified to produce vertical and near 45-degree angular fractures by modification of the tool. Lower breakdown and injection pressures made it possible to inject as much as 90,000 pounds of sand in one operation with a maximum 20-barrel per minute injection rate on another.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Viscous Fluid Measure

A new differential pressure liquid level transmitter, the Type 13 FA d/p Cell Transmitter, mounts directly on a tank nozzle to provide a simple method for measuring viscous or slurry-type liquids in open or closed vessels. Manufactured by The Foxboro Company, it operates on the force balance principle and maintains calibrated accuracy over a wide range of ambient conditions.

The level measuring element—a sili-

Here are some of the reasons why oil men call us "Bankers" and bankers call us "Oil Men": years of practical experience in *all* types of oil loans; service that includes Trust Dept. counsel. Remember, it pays to

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FIRST NATIONAL BANK & TRUST CO.

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MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

with **7** improvements

Aluminum castings reduce weight one-third to approximately 5-1/4 lbs. . . . Diameter of drive shaft increased from 7/16" to 1/2" for added strength . . . Gear train redesigned for more efficient operation . . . Both 15 cc and 100 cc sizes use the same crank . . . Spindle shaft ball bearing mounted, easier to turn . . . Drive shaft of corrosion resistant stainless steel . . . Spindle of corrosion resistant stainless steel.

Write for bulletin 53

W. H. CURTIN & CO.

DOMESTIC EXPORT • CURTIN LABORATORY APPARATUS, FURNITURE & CHEMICALS

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Established 1922 U.S.A.

FAILING rigs operated by Robert H. Ray, Ltd. in Pakistan, with temperatures 130° in the shade!

ROBERT H. RAY, LTD.

goes places

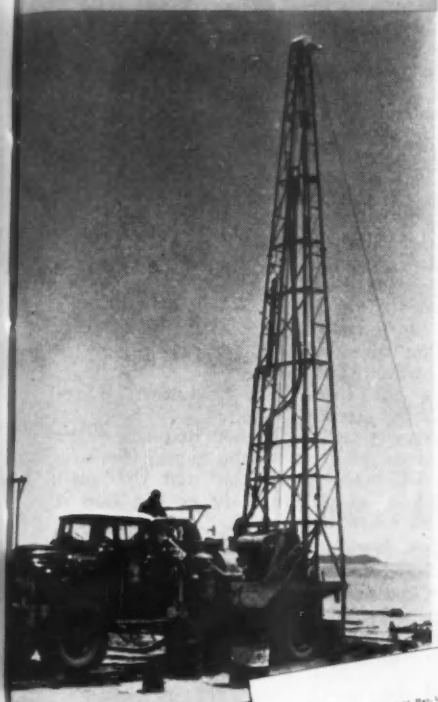
WITH FAILING RIGS

Gordon Causey,
Pakistan
Seismic Supervisor

drilling in sun temperatures up to 150° in Pakistan

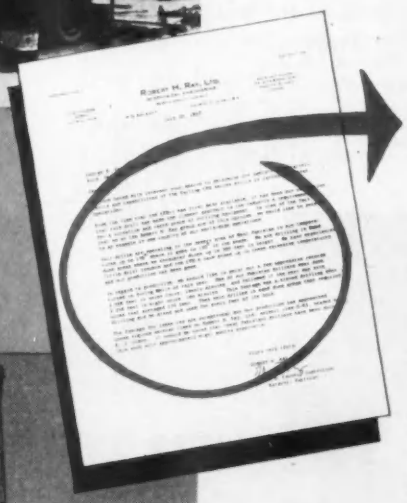
PAKISTAN is but one of 16 foreign countries in which the Robert H. Ray Company is drilling this year — in addition to crews operating in the United States, Alaska, Canada, and North Africa.

Since January, 1939, this progressive company has provided the petroleum industry with dependable, world-wide Geophysical Prospecting Service. With headquarters in Houston, Texas, the Robert H. Ray Company operates from 14 foreign offices in addition to those in the United States and Canada, employing more than 570 persons plus many national laborers. This letter gives additional details:



R.H.R. Unit 933 uses Failing 1500 drill for 12 month record of 100,000 feet of water-wells and shot holes.

R.H.R. Unit 934 uses Failing 1500 drill for 12 month record of 100,000 feet of water-wells and shot holes.



George E. Failing Company
Enid, Oklahoma
Gentlemen:

From the time that the CFD-1 was first made available, it has been our contention that this drill has made the closest approach to the industry's requirements for a versatile and rapid piece of drilling equipment. In view of the fact that we of the Robert H. Ray group are of this opinion, we would like to point to an example in one country of our world-wide operations.

Your drills are operating in the desert area of West Pakistan in sun temperatures up to 178° where it goes to 130° in the shade. We are drilling in sand dune areas where we encounter dunes up to 300 feet in height. We have experienced little drill trouble and the CFD's have stood up to these excessive temperatures and our production has been good.

In regard to production, we should like to point out a few impressive records turned in during March of this year. One of our Pakistan drillers went down 2,028 feet in seven hours, twenty minutes, and followed it the next day with 2,256 feet in eight hours, ten minutes. This footage was achieved drilling shot holes that averaged 170 feet. They were drilled in sand dune areas that required drilling mud be mixed and used for every foot of the hole.

The footage for these two are exceptional but our production has approached these figures several times on Robert H. Ray, Ltd. seismic crew S-93, headed by E. J. Glenn. It should be noted that these Pakistani drillers have been doing this work with approximately eight months experience.

Yours very truly,
ROBERT H. RAY, LTD.
Gordon D. Causey, Supervisor
Karachi, Pakistan

Egyptian drilling crew on Failing 1500 in Egypt.

GEORGE E. *Failing*® COMPANY

A subsidiary of Westinghouse Air Brake Company

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KINLEY TUBING PERFORATOR

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CASPER, WYOMING—C. A. White.....3-5264
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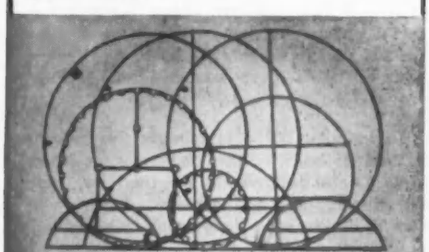
Need GASKETS for HEAT EXCHANGERS?



Call CHICAGO-WILCOX for PROMPT DELIVERY

Here is a dependable source for gaskets for heat exchangers. These gaskets can be made in any size or shape as needed—cut from solid metal, sheet-packing; also double jacket type.

Send specifications, blue prints or templates, for quotation and a prompt-delivery schedule for normal stocking orders.

CHICAGO-WILCOX MFG. CO.
7709 Avalon Avenue, Chicago 19, Ill.
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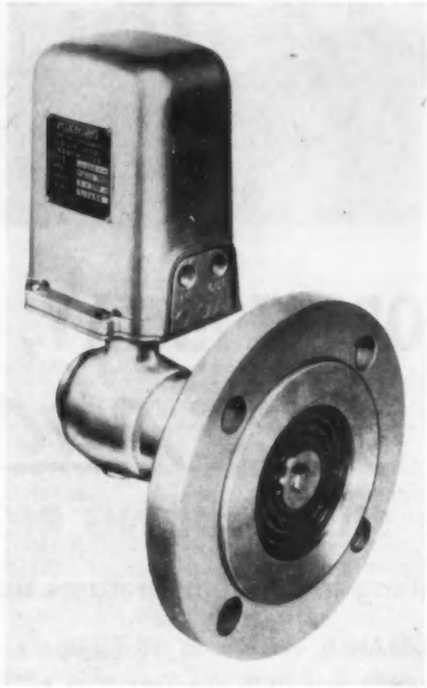


cone-filled diaphragm capsule—is assembled in a 3-inch flange for flush mounting on the side of a vessel. Head of liquid in the vessel applies force to the high pressure side of the capsule which is opposed by force on the low pressure side. The low pressure side may be open to atmosphere for measurement of open tank level. Or it may be connected by piping to the top of a closed tank to balance out static pressure. Adjustable range suppression and elevation springs can be easily attached to accommodate the various installation arrangements.

(This item supplements The Foxboro Co. data on Pages 1782-1785 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

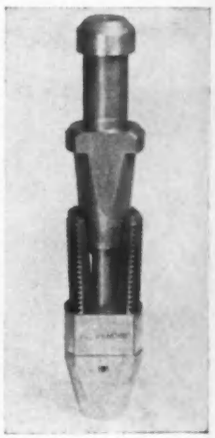
Emergency Kit Repair

A new emergency repair kit containing Plastic Steel for on-the-spot repairs of tanks, pipes, pumps, valves and other types of machinery is now available through industrial supply dealers, according to Devcon Corporation, the manufacturer.

Plastic Steel is a combination of 80 percent steel and 20 percent plastic. It's as easy to use as modeling clay; can be formed into any shape and will not run or sag when applied to a vertical surface. Two hours after the addition of a special hardening agent (supplied), Plastic Steel becomes an extremely strong, tough, rigid metallic piece. No heat or pressure is required. It is durable, permanent, essentially non-shrinking or expanding, does not rust. Plastic Steel does not depend upon evaporation for hardening; will even harden under water.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

Wire Line Tubing Stop



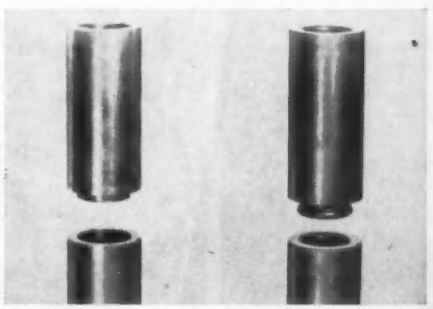
A new tubing stop for wire line has been announced by the Harold Brown Company.

This stop features a design with large by-pass area—in 2 inch tubing it is equivalent to 1 inch opening and in 2½ inch tubing it is equivalent to 1¼ inch opening. The specially designed slips will support shock loads up to 100,000 lbs. Positive hold-down on slips insures maximum running speed without prematurely setting the slips. The hold-down is released by jarring down.

There is no danger of disturbing the corrosion products in the tubing because there is nothing on the tool that will scratch or rub. The body of the stop is of 4140 heat-treated steel.

(This item supplements Harold Brown Co. data on Pages 871-873 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E14** on Readers' Service Card, last page this issue.



Tubing Protectors

A new line of overlapping and interlocking rubber tubing protectors is announced by Byron Jackson Tools, Inc., a subsidiary of Borg-Warner Corporation. The new protectors are of a convenient size that can be stretched on the tubing in an overlapping series to present a formidable length of solid rubber protection for the long tubing as it passes through the upper pay zone. The lip of one protector laps over the tongue of the next; the shoulders butt tightly together so that no abrasive matter can get through to the tubing.

(This item supplements Byron Jackson Tools, Inc., a subsidiary of Borg-Warner Corp., data on Pages 973-1108 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E15** on Readers' Service Card, last page this issue.

The Most Economical Pumping Unit Ever Built

. . . and the SMOOTHEST OPERATING

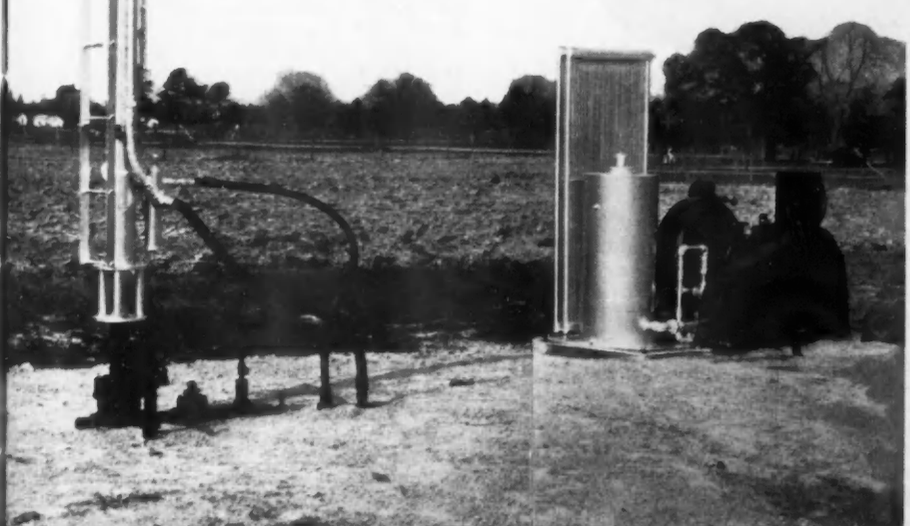
JOHNSTON
Hydraulic
PUMPING UNITS

The low price of Johnston Hydraulic Pumping Units is due to streamlined, simplified design and manufacture, made possible by years of experience in production and hydraulics.

From grass roots to 9000 feet—that's the range of Johnston Hydraulic Pumping Units. They may be powered by electric motor or any type internal combustion engine.

Remember this. Here is a pumping unit that will SAVE YOU MONEY—Cost you Less than any competitive unit. Less for Transportation; Less for Installation; Less for Maintenance; Increase Life of Sucker Rods, Bottom Hole Pump, and in many instances increase production.

3 FT. STROKE **6 FT. STROKE** **9 FT. STROKE** **12 FT. STROKE**



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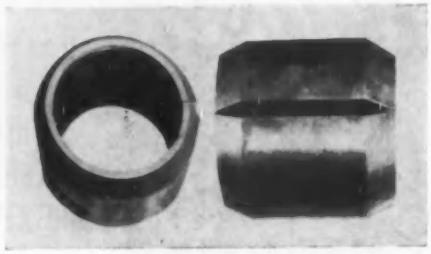


Pipe Pressure Equalizer

A new tool which aids in solving the problem of the sticking of pipe opposite permeability because of differential pressure has been developed by the Weatherford Oil Tool Company, Incorporated. It is called a drill pipe differential pressure equalizer and protector.

Other important purposes of the tool are:

1. Reduction of wear on the drill pipe and tool joints.
2. Reduction of frictional drag, both in rotation and reciprocation of the drill pipe.

Weatherford's equipment reduces the area of contact of the drill pipe with the well bore, permitting the hydrostatic pressure to be equalized around the drill pipe with the well bore for the whole length of the pipe with the exception of the area of contact of the equalizers and tool joints.

This tool employs steel rather than rubber and the two halves are welded together. Welding rather than hinging is employed for two reasons—safety of the drilling crew and security of the tool against being lost in the well bore. A hinged device, to meet safety requirements, would be too massive and expensive for economic operation.

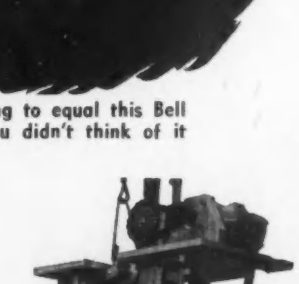
(This item supplements Weatherford Oil Tool Co., Inc., data on Pages 5322-5325 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E16** on Readers' Service Card, last page this issue.

"In all my years on the rig floor, I've never seen anything to equal this Bell Pneumatic Weight Control. It makes you wonder why you didn't think of it yourself."

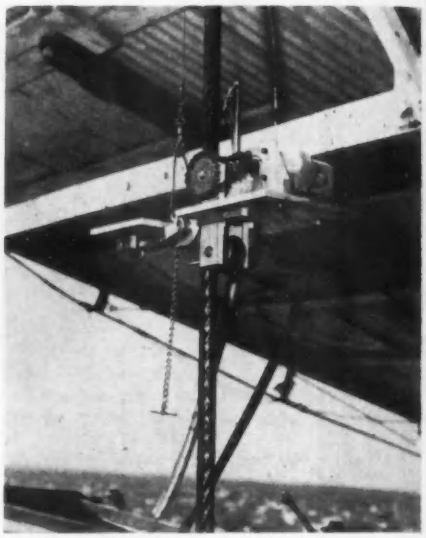
The new Bell Pneumatic Weight Control has begun to be written into contract specifications . . . and small wonder! This amazingly simple device gives the most precise control of weight on bit in *all* drilling—*coring included*. It can be installed on any rig in 1½ hours, removed in 20 minutes. It does not need to be removed when making up or breaking out joints. Just snap it off the drilling line and it hangs free—out of the way—until you're ready to put it back into use.

The Bell *Pneumatic* Weight Control was developed as an improvement on the original electric unit—another step forward in the drilling industry's program of elimination of fire hazards at the rig. Both models, however, remain available at the choice of the operator. Operation is the same with either model. Most important—drillers really like it and use it.



Complete details on design, function and operation are available in an illustrated booklet just off the press. Write for your free copy today.

BELL CORP.
P. O. Box 4062 - 2031 Andrews Highway
ODESSA, TEXAS



Pneumatic Weight Control

A rash of West Texas rig fires some months ago, which set off a series of intensified safety campaigns, gave rise to the conversion of the Bell Automatic Weight Control from electric to pneumatic operations. According to Leo Bell, inventor of the new device and founder of the Bell Corporation, no blame could be traced to the new weight control, but operators nevertheless began requesting a weight control actuated by some means other than electricity.

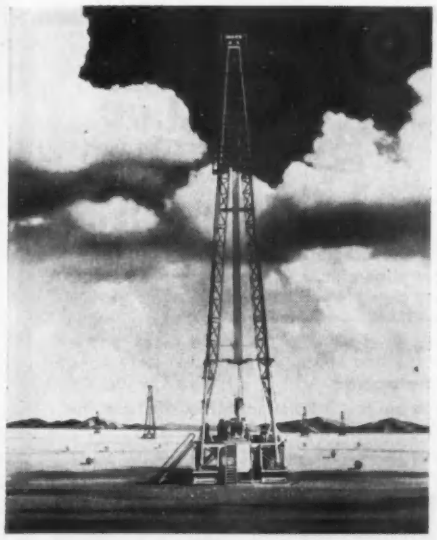
Bell's unit is a device which governs weight on the bit by automatically setting or releasing the brake according to predetermined requirements. Sensings from a hydraulic diaphragm on the deadline are interpreted into impulses which actuate a "crawler" mounted on the drilling line a few feet above the drum. As more weight is required at the bit, the crawler moves downward on the drilling line, lifting the brake handle by means of a cable drawn through an overhead pulley. When the proper weight is set down on the bit, the crawler remains at rest. Weight setting and crawler speeds are governed at the control panel.

(This item supplements Bell Corporation data on Page 2297 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E17** on Readers' Service Card, last page this issue.

Junior Full-View Mast

A new highly portable free-standing mast for medium-depth drilling has been announced by IDECO, Inc., one of the Dresser Industries. Named the Junior Full-View, the new mast has the same basic structural design and raising system of the larger Full-Views now in worldwide operation. Nominal gross column capacity is 450,000 pounds and rated hook capacity is 300,000 pounds with eight lines strung. Exceptional stability and re-

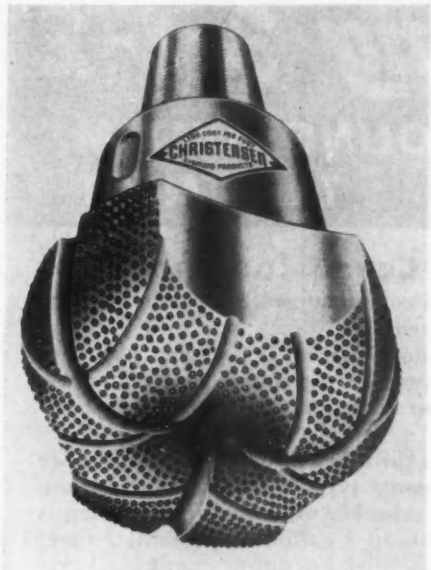


served strength has been confirmed by comprehensive strain gage tests under maximum loaded conditions.

New features of the mast include twin columns with a triangular cross-section which are joined above the racking platform into a one-piece top section. A new arrangement by which it may be changed from a 98-foot doubles to a 132-foot trebles mast simply by adding one section and reversing pedestals and base shoes makes the mast easily adaptable for a variety of applications.

(This item supplements IDECO, one of the Dresser Industries, data on Pages 2665-2732 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E18** on Readers' Service Card, last page this issue.



Cloverleaf Bit Design

This drilling bit, incorporating oversize cutaway sections, is designed for combatting the problem of sticking, frequently encountered in deep or sluffing holes. The large cut-outs permit the circulation of junk or loose formation off the bottom of the hole, thus minimizing the possibility of damage when starting the bit or making a connection. This design also prevents swabbing of the hole or any hydraulic action when tripping.

Like all Christensen bits this design can be altered to meet the requirements of

More than a mere pipe fitting!

catawissa
PERFECT SEAL
unions

give a 3 to 1 safety factor
PLUS
A PERFECT SEAL!

THERE'S A CATAWISSA PERFECT SEAL UNION FOR EVERY USE . . . ALL TEMPERATURES, ALL PRESSURES!

The full dependability of HOT FORGED STEEL is yours in a Catawissa Union (hot forged from solid steel bars) with several extra value features that are exclusive here at the UNION SPECIALISTS!

All Catawissa Unions are designed to give a 3-to-1 SAFETY FACTOR . . . 3,000-lb. service unions are tested to 9,000-lbs., 6,000-lb. service unions tested to 18,000-lbs., etc.

Exclusive Ball-to-Angle seat design assures a PERFECT SEAL even when the pipe is not in alignment!

Machining operations assure a UNIFORMITY AND ACCURACY heretofore found only in special fittings and, with rigid inspection both during and after machining, guarantees LEAKPROOF CONSTRUCTION!

Satisfaction is guaranteed in any application—whether it be general low pressure service or extremely high pressures and temperatures (for air, oil, gas, chemicals, hot oils, gases or steam).

WRITE FOR CATALOG 11

AVAILABLE FROM LEADING INDUSTRIAL SUPPLY FIRMS

CATAWISSA VALVE & FITTINGS COMPANY

60 MILL STREET ★ CATAWISSA, PENNA.

For more data on advertised products, use Readers' Service Cards, last page.

6 page bulletin describes Metering Separators

Packed with information, Bulletin 56MS describes Rolocheck Metering Separators — the units which are enabling operators everywhere to save on flow lines, tanks, and other equipment.

For very little more than you'd pay for a separator alone, you get an efficient separator *plus* a genuine Rolocheck Meter complete in one vessel . . . a unit which *separates and meters* the production.

Each unit has the Rolo Neutral Position Three Way Valve which absolutely prevents unmetered fluids from by-passing the meter.

ROLOCHECK TWO PHASE METERING SEPARATOR– separates oil and gas, metering the oil.

ROLOCHECK THREE PHASE METERING SEPARATOR– separates oil, gas and water — metering the oil and water independently by separate Rolocheck Meters.

Full details are contained in Bulletin 56MS. Write for it today.

Rolo Manufacturing Company

P. O. Box 6763 Houston 5, Texas

WHY NOT LET BrakeSolve YOUR PARAFFIN Problem?

BRAKESOL is the safe, economical way to clean up and control paraffin in your production system. By using BRAKESOL, you get more production, by reason of having unrestricted flow and by avoiding those tank bottoms.

BRAKESOL is being used all over the world today and is accepted as one of the most effective methods of treating and controlling the paraffin problem.

BRAKESOL is safe to use and will not harm the skin, and the danger of fire hazard has been greatly minimized.

BRAKESOL is non-corrosive and will not harm production or refinery equipment.

HOLDS PARAFFIN IN SUSPENSION from FORMATION to REFINERY

Ardmore, Okla.	6489
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GOOD SERVICE NEAR YOU

There's a BRAKESOL Treating Engineer near you who can show you the most effective methods of application to solve your paraffin problem . . . in one easy operation. Contact him TODAY, he'll be glad to help you. For additional information, write us direct, or contact your local supply store.

BrakeSol INC.

P.O. Box 9506 Oklahoma City, Okla.

Export Distributor: The National Supply Co., Export Division

Young 3-1-2 COOLING SYSTEM TREATMENT

Rust and Corrosion Inhibitor

Young 3-1-2 is a complete protective treatment for the cooling systems of diesel, gas and gasoline internal combustion engines. It prevents rust, controls scale, and protects aluminum, copper, ferrous metals, etc., from corrosion; and non-metals from deterioration.

Young 3-1-2 is furnished in pellet form, and since it is a *non-chromate* type treatment, it is non-irritating to the skin. No weighing or measuring is required: *3* pellets to *1* gallon of coolant, 2 times a year (under normal operating conditions) are recommended.

Young 3-1-2 will not deteriorate with age when stored in a dry area. It is compatible with all types of standard anti-freezes.

For further information write Dept. R977-K

Young RADIATOR COMPANY

RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

the rock to be drilled. Almost any combination of waterways and/or diamond pattern can be utilized, in either a three or four pad design.

(This item supplements Christensen Diamond Products Co. data on Pages 1321-1344 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E19** on Readers' Service Card, last page this issue.

High-Strength Mast

Engineers of the Lee C. Moore Corporation, by using U.S.S. Man-Ten Steel, a high-strength steel, saved approximately 15,000 pounds in the weight of an offshore drilling mast.

U.S.S. Man-Ten Steel, one of the earlier of the steel industry's high strength steels, was developed by U. S. Steel before World War II. In fact, Lee C. Moore engineers have been putting it to use in portable drilling masts and derricks for some 20 years. Thus, when they designed the new mast they called on the high strength product they had so long employed. Here was the result:

They came up with a 140-foot portable steel mast capable of handling the requirements of the deepest current offshore drilling. Yet, by placing U.S.S. Man-Ten Steel at points of greatest stress—which figured out to approximately 34 percent of the total steel—they cut the total weight by about 15,000 pounds over that of a similar size and strength mast using carbon steel entirely. Such a saving is designed to offer numerous features attractive to the offshore driller, each adding up to savings in the all-important matter of expenses.

(This item supplements Lee C. Moore Corp. data on Pages 3597-3632 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E20** on Readers' Service Card, last page this issue.

Self-Sufficient Generator

A new and more powerful direct current, diesel-electric generating unit for oil-well drilling—completely self-sufficient with its own built-in alternating current generating system for auxiliary purposes—is announced by Electro-Motive Division of General Motors.

A load regulator automatically provides

SERVICE...PLUS EQUIPMENT YOU CAN DEPEND ON

All of our suppliers are well-known in the oil industry. We have worked with many of them for over 25 years in supplying our customers with quality products that they could depend on with confidence.

Our service is known throughout the Iverson Supply Company area for the speed and efficiency with which customers orders are filled. And, all equipment handled is backed by the Iverson Guarantee of Satisfaction.

A PARTIAL LIST OF OUR SUPPLIERS

Alten Foundry & Machine Works, Inc.
Baker Oil Tools, Inc.
Brewster Company
Byron-Jackson Oil Tools
Cameron Iron Works
Coffing Hoist Division
Dresser Manufacturing Division
Exner Dodge, Inc.
Gardner-Denver Company
Goodall Rubber Company, Inc.
Guiberson Corporation
Ideco Rotary Equipment
Lee C. Moore Corp.
McKissick Products Corp.
Orbit Valve Company
Rector Well Equipment Co., Inc.
Reed Roller Bit Company
Skinner Bros. Co.
Spang & Company
Wall Rope Works
Walworth Company
Waukesha Motor Company
Web Wilson Oil Tools

IVERSON SUPPLY STORES

OKLAHOMA — Oklahoma City, Okmulgee, Tulsa.
NEW MEXICO — Artesia, Farmington.
TEXAS — Kermit, Odessa, Snyder.
COLORADO — Cortez

OFFICES: FT. WORTH, DALLAS & MIDLAND, TEXAS

IVERSON SUPPLY COMPANY
DRILLING-PRODUCTION AND REFINERY EQUIPMENT
GENERAL OFFICES
P. O. BOX 1439 TULSA 1, OKLA.

OFFICES: DENVER, COLORADO TULSA, OKLAHOMA

At the installation site *(above)* Polk used their new B-70 tractor for this tough hauling job. *(right)* This rigger's truck (a Mack B-80) was used for loading and unloading the 215,000-lb. compressor.

How to handle a 107½-ton Compressor!

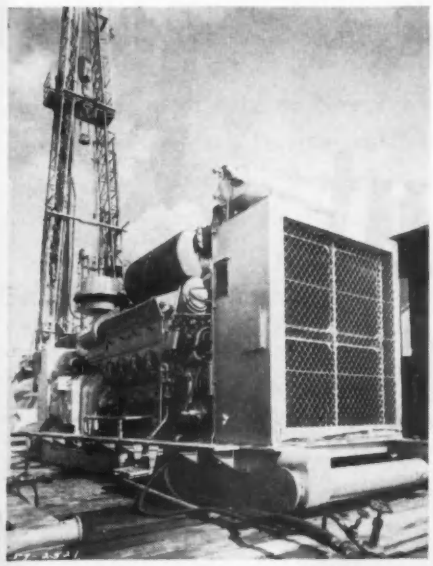
"Get yourself a couple of Macks—a tractor for pulling the low-boy and a rigger's truck for the bull work." That's the way the H. C. Polk Trucking Company of Prentiss, Mississippi, handled the moving and placement of this 215,000-lb. compressor recently installed in Greenville.

"We have been hauling in the oil fields for many years . . . long enough to know that the trucks we can really depend upon are Macks. They've got what it takes for heavy hauling over the rough terrain and through the gumbo mud we usually encounter. Their engines withstand sustained low-gear pulling and long periods of heavy winching. Mack transmissions, rear ends, and Balanced Bogies are second to none for low maintenance and long service."

This is what Mr. H. C. Polk, president of Polk Trucking, says about Macks. A Mack user for over 10 years, he's typical of the heavy oil field haulers who have found that for cost-saving, dependable operation nothing beats Mack heavy-duty trucks and tractors. They're real profit-makers! Why not let your Mack representative give you full details and specifications. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

MACK
first name for
TRUCKS

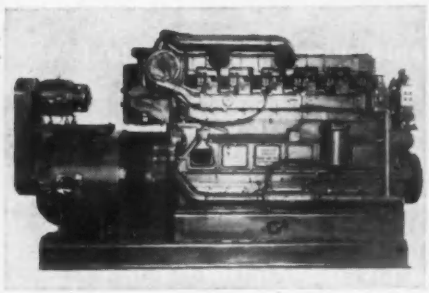
5172



the load demand of the driller without overloading the engines. Thus, the engines can be loaded to their full ratings giving the contractor more usable power for his horsepower dollar.

The new unit, designated SR-10, is 2000 pounds lighter in the air-cooled model. It is a more powerful unit than its predecessor with generator ratings up from 500 to 640 kw and motor horsepower increased from 625 to 800. Horsepower of the General Motors model 8-567CR engine has been increased to 1000 continuous in the new unit.

For more data, circle **No. E21** on Readers' Service Card, last page this issue.



450 HP Turbodiesel

Cummins Engine Company, Inc. has announced production of a new 450 horsepower Turbodiesel engine for use in pumping units, locomotives, marine equipment, oil well drilling rigs, shovels and electric power generation.

The Cummins LRT-6 Turbodiesel broadens the hp range of the slow speed, heavy duty L engines offered by Cummins. Previous models in the L series developed 250 and 300 horsepower.

The Cummins Turbodiesel engine utilizes normally wasted energy of exhaust gases, by means of a turbocharger, to develop additional hp. A turbine, located in the exhaust system, drives a centrifugal blower in the air intake system. By forcing a greater weight of air into the cylinders, more fuel can be burned completely and more power developed.

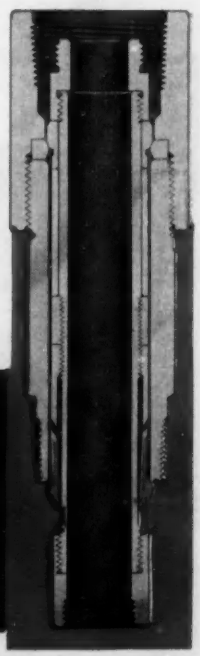
(This item supplements Cummins Engine Co., Inc. data on Pages 1421-1440 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E22** on Readers' Service Card, last page this issue.

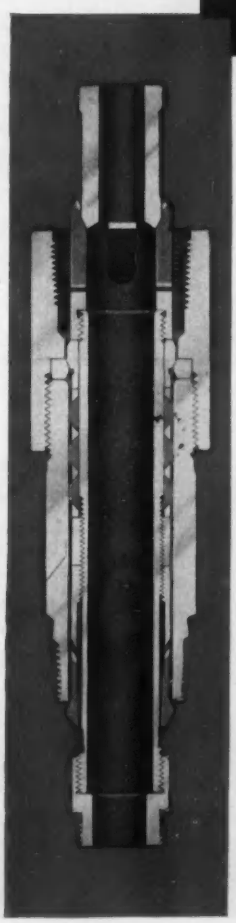
Wireline servicing made easy with a

PACIFIC PERMANENT COMPLETION PUMP HOLD DOWN

The Pacific Permanent Completion Hold-Down is designed with maximum opening through the shoe to permit use of Permanent Completion Tools through it. The sealing arrangement has replaceable Stainless Steel Sealing Ring with a reversible Stainless Steel Sealing Ring Seat and can be used on any type A.P.I. rod pump.



Undersize rings can also be furnished to allow pumps to be run through a Permanent Completion "S" Nipple and seated in the pump shoe.



If at any time the Stainless Sealing Ring Seat, which is part of the Tubing Assembly, should become damaged or leak, an effective seal can be obtained without pulling tubing. The Rod Assembly is engineered and designed so that by replacing the Spacer Ring on the Hold-Down Lock Body with three Ring Type Seating Cups, the seal is transferred to the Seat Support Nipple with the Sealing Ring and Sealing Ring Seat serving as a No-Go ring and supporting the load.

PACIFIC PUMPS, INC.

HUNTINGTON PARK, CALIFORNIA

Offices in all Principal Cities

Mid-Continent Division: 1221 E. 1st St., Tulsa, Oklahoma

Pacific Pumps of Canada, Ltd., Edmonton, Alberta

PACIFIC®

DW-17

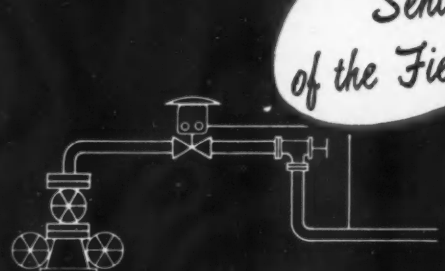
FISHER®

Hi-Low Cutout Controllers

The Sentinel of the Field

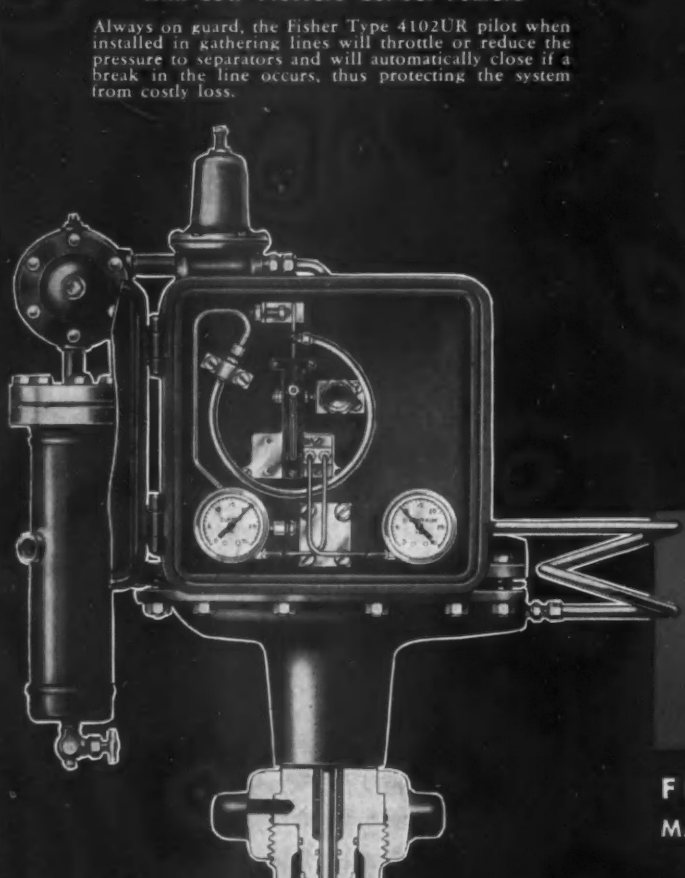
Type 4102UR-125-P Field Valve With Low Pressure Cut-out Feature

Always on guard, the Fisher Type 4102UR pilot when installed in gathering lines will throttle or reduce the pressure to separators and will automatically close if a break in the line occurs, thus protecting the system from costly loss.



Type 4102U-125-P On-Off Valve With High-Low Cut-Out Feature

Ideal as a high-low pressure well head safety valve. Will stay open, but will automatically close if pressure goes above pressure limitations of downstream piping. Will also close if pressures fall too low *due to* a break in downstream system.



- Wizard available with bronze or steel Bourdon tubes up to 5000 psi.
- Rugged and compact—entire controller not over 2 feet high.
- Series 125–P field valve supplied with heavy cast steel body good for 2000 psi.
- Topwork action reversible in field with no additional parts.

SPECIFICATIONS

Body—Cast Steel—2000 psi WOG.
Sizes—1" and 2" screwed angle or globe.

Orifice Size—1" Body—¼", ⅜", ½", ⅝". 2" Body—¼", ⅜", ½", ¾", 1".

Valve Cage—440 hardened St. Steel. (Tungsten carbide insert also available.)

Inner Valve—440 hardened St. Steel. (Tungsten carbide tip also available.)

FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA • WOODSTOCK, ONTARIO

LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER *Since 1880*

New Equipment Catalogs and Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader's Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

Gas Regulator Catalog

A new 40-page catalog covering their complete line of pressure regulators for industrial compressed gases has just been made available by Airco Company International. Entitled "Gas Regulators," Catalog 806 deals with various types of cylinder, manifold and pipe line regulators, both single- and two-stage, and a variety of specialized equipment such as laboratory and metering regulators and gas proportioners. Flow and pressure charts in graph form give data on the performance of the regulators.

To get a copy, circle **No. E23** on Readers' Service Card, last page this issue.

Powers Industrial Catalog

More than 34 basic types of industrial temperature and pressure controls are described in a new industrial catalog announced by the Powers Regulator Company, Skokie, Ill., manufacturer of automatic controls.

Included in the 96-page book are self-operating regulators, water mixing equipment, pneumatic control instruments, indicating and recording instruments, control valves and pneumatic motors.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

Bearings Catalog

Non-lubricated bearings made from carbon graphite material is the subject of a new 16-page catalog. These bearings operate under very high temperatures, are chemically inert and have overcome many maintenance problems for industry. Carbon graphite bearings in operation are illustrated in ovens, process equipment, conveyors etc. Also included are nomograph charts, grades and design information.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

Darling Valve Catalog

Just off the press is a complete new 244-page catalog covering Darling gate valves, check valves and fire hydrants in a broad range of types, sizes and constructions, according to the Darling Valve and Manufacturing Company.

To get a copy, circle **No. E26** on Readers' Service Card, last page this issue.

Filter Paper Booklet

The Eaton-Dikeman Company announces the publication of a new 24-page catalog on industrial filter paper. This "work-book," liberally illustrated with photographs, charts and diagrams, presents a clear, concise review of filtration practice, explains how paper, as a filtering media, helps solve problems in laboratory and industrial use, and is an indispensable aid in selecting one of the many grades of E-D Industrial Filter Paper for scores of applications.

To get a copy, circle **No. E27** on Readers' Service Card, last page this issue.

Motor Starter Bulletin

Allis-Chalmers complete line of motor starters and contactors in sizes 4, 5 and 6 (Type 425), 50 to 400 horsepower, is described in a new 12-page bulletin released by the company. Designed to assure full rated capacity, maximum motor protection, longer life and easy maintenance, these starters and contactors have been applied to practically all types of drives including pumps, crusher, blowers, fans, screens and furnace controls.

To get a copy, circle **No. E28** on Readers' Service Card, last page this issue.

Fludex Brochure

Tretolite Company of St. Louis has issued a brochure fully describing Fludex, a new water-flood and water-disposal stimulator. Fludex is identified as an effective bacteriostatic agent for the control of sulfate-reducing organisms, as a corrosion inhibitor, and as a scale preventive, in addition to being an excellent wetting agent which will condition the surfaces of the formation and permit faster and easier injection of water at lower operating conditions. How much Fludex is required and specific application in such areas as pumping wells with open casing, water disposal and water-flood systems, and backwashing formations also receive careful attention.

To get a copy, circle **No. E29** on Readers' Service Card, last page this issue.

Free Viscosity Analysis

Fischer & Porter Company offers a complimentary analysis of individual problems in the viscosity measurement of liquid petroleum streams.

Engineers of F&P's Viscosity Application section have prepared a special data sheet which, when filled in, gives a profile of the applicant's viscosity problem. The data sheet is so designed that, after completion, it may be folded and mailed postage free to the company's Application Engineering section. Engineers at F&P then analyze the information supplied and return to the applicant an ASTM Temperature-Viscosity chart along with their recommendations.

To get a copy, circle **No. E30** on Readers' Service Card, last page this issue.

Gas Lift Valve Bulletin

Otis Pressure Control, Inc. has published a new six-page bulletin on its line of Type C gas lift valves. The literature contains full-color illustrations, including cutaway sections of the equipment, flow courses etc.

To get a copy, circle **No. E31** on Readers' Service Card, last page this issue.

Small-Case Instruments

Fischer & Porter Co. has just published a catalog describing the company's new small-case instrument line for indicating, transmitting and controlling pressure and temperature. These instruments —to be called the Series 1450 line—are housed in fiber glass cases, making them particularly suitable for use outdoors or in corrosive atmospheres.

To get a copy circle **No. E32** on Readers' Service Card, last page this issue.

Land Rover Bulletin

A very complete 28-page booklet has been issued by the Rover Company Ltd. on the 4-Wheel Drive "go anywhere" Land Rovers now available with either gasoline or diesel engine power. The booklet gives illustrations of all five Land Rover models including power charts and the construction features that make these rugged vehicles particularly well suited for oil field exploration and producing operations.

To get a copy, circle **No. E33** on Readers' Service Card, last page this issue.

Tension Tools Catalog

In a comprehensive oil tool catalog, the Page Oil Tool Co. fully illustrates and describes every item in its complete line of Page tension tools. Particular emphasis is placed on the tubing anchors, tubing drains, both mechanical and hydraulic, bottom hole oil and gas separators. The catalog also describes at some length the Page automatic well flow controllers and sampling or shut-off valves.

To get a copy, circle **No. E34** on Readers' Service Card, last page this issue.

Gas Drying Bulletin

A new technical brochure on molecular sieves is now available from Linde Company, division of Union Carbide Corp. Complete information is given on using molecular sieves as a superior drying agent for gases. Tables and charts provide engineering data for preliminary designs of low-dewpoint drying systems.

To get a copy, circle **No. E35** on Readers' Service Card, last page this issue.

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